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# An Exploratory Assessment of the Effects of Specified Cultural and Environmental Factors on the Performance of Nigerian Students on Selected Verbal and Nonverbal Aptitude Tests Developed for Use in Western Countries

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AN EXPLORATORY ASSESSMENT OF THE EFFECTS OF SPECIFIED  
CULTURAL AND ENVIRONMENTAL FACTORS ON THE PERFORMANCE  
OF NIGERIAN STUDENTS ON SELECTED VERBAL AND  
NONVERBAL APTITUDE TESTS DEVELOPED FOR  
USE IN WESTERN COUNTRIES

by

Victoria Belle Chigoziri Iwuji

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1977

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## VITA

Victoria Belle Chigoziri Iwuji is the daughter of MacDonald Iwueze Iwuji and Rebecca Chioma Okechukwu-Iwuji. She was born on June 10, 1938 in Obollo, Mbano Division, Imo State Nigeria.

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Under the auspices of the Franklin Juvenile Book Company, she wrote "Going to A Moonlight Play" a supplementary English reading book for primary 5 and 6 grade children which was published in April, 1966 in Nigeria.

## TABLE OF CONTENTS

CHAPTER	PAGE
I. STATEMENT OF THE PROBLEM AND RATIONALE.....	1
Manpower Problem Facing Some African Nations	
After Independence .....	1
Efforts Made by the Nigerian Government to	
Solve the Problem .....	2
The Rationale for the Internationally-Developed	
Tests .....	3
A Constructive Role of a Testing Program in a	
Nation's Educational System .....	6
A Case for Aptitude Testing in Schools .....	8
Summary .....	13
The Purpose of the Present Study .....	13
Type and Nature of Tests Used for the Study	
and the Rationale for Selecting Them .....	16
Type of Study: Exploratory Research	
Study .....	19
Hypotheses Testing Versus Hypotheses	
Generating Research Studies .....	21
Conditions Necessary for "Relevant" Predictive	
Validity Studies .....	23
II. REVIEW OF RELATED LITERATURE .....	27
Introduction .....	27
Test Classifications .....	27
Intelligence Versus Aptitude Tests .....	28
Achievement Versus Aptitude Tests .....	30
Personality, Attitude, & Interest Inventories ....	30
What Type of Tests Are Psychometrically Acceptable	
for Use in African Developing Nations? .....	31
The Concept of "Adaptability" As A Suggested	
Alternative for Tests of General Intelligence	
Among the Developing Nations .....	34
Test Adaptation: A Solution to the Problems of the	
Developing Nations .....	40
Definition .....	40
Rationale .....	41
Should the Developing Nations Reconstruct the	
Items of Western-Developed Ability Tests to	
Reflect Existing Conditions in Their	
Traditional Cultures? .....	42

Studies Which Used Western Developed Ability Tests in Their Original Forms in Nigeria .....	43
The Impossibility of Constructing a Culture-Free Test ..	50
Effective Utilization of Western-Developed Aptitude Tests in the African Developing Nations .....	53
Recapitulation .....	55
 III. DEVELOPMENT OF SOCIOECONOMIC STATUS AND WESTERN CULTURE PARTICIPATION INVENTORY .....	58
Purpose .....	58
Socioeconomic Status and Its Cultural Implications .....	58
The Construction of SES Index .....	60
Western Culture Participation: Rational Behind Its Inclusion in the Specified Independent Variables ....	61
The Construction of the Western Culture Participation Index .....	62
Validation of the Socioeconomic and Western Culture Participation Inventory .....	64
Type of Validation .....	64
Sampling Procedure and the Sample .....	65
Instrumentation .....	66
Scoring .....	66
Analysis .....	66
Results and Discussion .....	67
 IV. PILOT STUDY .....	71
Why a Pilot Study was Necessary .....	71
Sample for the Pilot Study .....	72
Instruments .....	72
Procedure .....	73
Observations During the Testing Sessions .....	74
Analysis of Data .....	74
Results and Discussion .....	75
 V. MAJOR STUDY .....	79
METHOD .....	79
Sampling Procedure .....	79
Subjects .....	82
MATERIALS .....	86
The Differential Aptitude Tests (DAT) .....	86
The Verbal Reasoning Test .....	88



The Numerical Ability Test .....	89
The Abstract Reasoning Test .....	90
The Mechanical Reasoning Test .....	90
The Space Relations Test .....	91
The Raven's Progressive Matrices .....	91
PROCEDURE .....	92
Preparations .....	92
Instrumentation .....	93
STATISTICAL ANALYSIS .....	94
Introduction .....	94
Assumptions .....	94
Statistical Technique .....	95
Post-hoc Analyses .....	98
Control of Confounding Factors .....	100
VI. RESULTS .....	104
General Descriptions .....	104
Data Analyses Results of the Verbal Reasoning Test	
Performance .....	107
Data Analyses Results of the Numerical Ability Test	
Performance .....	115
Data Analyses Results of the Abstract Reasoning Test	
Performance .....	122
Data Analyses Results of the Mechanical Reasoning Test	
Performance .....	128
Data Analyses Results of the Space Relations Test	
Performance .....	135
Data Analyses Results of the Raven's Progressive	
Matrices Performance .....	140
VII. DISCUSSION .....	146
General Discussion .....	146
The Effects of Socioeconomic Status and Western	
Culture Participation on the Nigerian Students'	
Performance on the Western-Developed Aptitude Tests..	150
Urban-Rural Effect on Western-Developed Aptitude	
Tests Performance in Nigeria .....	154
The Effect of Number of Years of Schooling (Class) on	
Nigerian Students' Performance on Western-Developed	
Aptitude Tests .....	157
Sex-Differences in the Performance of Nigerian Students	
On the Various Types of Aptitude Tests Used in the	
Present Study .....	159

CHAPTER	PAGE
General Conclusions .....	164
Educational Implications and Recommendations .....	167
SUMMARY .....	176
REFERENCES .....	181

## LIST OF TABLES

TABLES	PAGE
1a. A Breakdown of Socioeconomic Status Scores by Subgroups Showing Significance of Mean Differences .....	69
1b. A Breakdown of Western Culture Participation Scores By Subgroups Showing Significance of Mean Differences..	70
2a. Analysis of Data for the Pilot Study: A Breakdown of Students' Scores on Each of the Aptitude Tests Showing Means and Standard Deviations According to Class, Sex, and School Locations .....	77
2b. Intercorrelation Matrix of Scores on SES, WCP, and the Selected Aptitude Tests .....	78
3a. Frequency Distribution of the Sample Population Showing the Absolute And Relative Sizes of the Various Subgroups .....	83-84
3b. Intercorrelation Matrix of the Dependent and Independent Variables Showing the Degree of Associations of the Variables with One Another .....	103
3c. Descriptive Statistics of Class IV Students' Scores on the Various Aptitude Tests Showing Means, Standard Deviations, Minimum, and Maximum Scores for Boys', Girls' and Mixed Schools in Urban and Rural Areas .....	105
3d. Descriptive Statistics of Class V Students' Scores on the Various Aptitude Tests Showing Means, Standard Deviations, Minimum and Maximum Scores for Boys', Girls', and Mixed Schools In Urban and Rural Areas ....	106
4a. Analysis of Covariance Results Showing Sources of Group Variations in Performance on the Verbal Reasoning Test .....	111
4b. Multiple Classification Analysis for Performance on the Verbal Reasoning Test Showing Subgroup Mean Deviations From the Grand Mean .....	112

4c.	Interactions Table for Performance on the Verbal Reasoning Test Showing Class by Sex Interactions According to School Locations .....	113
4d.	Specified Subgroup Mean Scores on the Verbal Reasoning Test Showing Pattern of Subgroup Differences in Urban and Rural Located Schools .....	114
5a.	Analysis of Covariance Results Showing Sources of Group Variations in Performance on the Numerical Ability Test .....	118
5b.	Multiple Classification Analysis for Performance on the Numerical Ability Test Showing Subgroup Mean-Deviations From the Grand Mean .....	119
5c.	Interactions Table for Performance on the Numerical Ability Test Showing Class by Sex Interactions by School Locations .....	120
5d.	Specified Subgroup Mean Scores on the Numerical Ability Test Showing The Pattern of Subgroup Differences in Urban and Rural Located Schools .....	121
6a.	Analysis of Covariance Results Showing Sources of Group Variations in Performance on the Abstract Reasoning Test .....	124
6b.	Multiple Classification Analysis for Performance on the Abstract Reasoning Test Showing Subgroup Mean Deviations from the Grand Mean .....	125
6c.	Interactions Table for Performance on the Abstract Reasoning Test Showing Class by Sex Interactions by School Location .....	126
6d.	Specified Subgroup Mean Scores on the Abstract Reasoning Test Showing Pattern of Subgroup Differences in Urban and Rural Located Schools .....	127
7a.	Analysis of Covariance Results Showing Sources of Group Variations in Performance on the Mechanical Reasoning Test .....	131
7b.	Multiple Classification Analysis for Performance on the Mechanical Reasoning Test Showing Subgroup Mean-Deviations from the Grand Mean .....	132

7c.	Interactions Table for Performance on the Mechanical Reasoning Test Showing Class by Sex Interactions by School Location .....	133
7d.	Specified Subgroup Mean Scores on the Mechanical Reasoning Test Showing Pattern of Subgroup Differences in Urban and Rural Located Schools .....	134
8a.	Analysis of Covariance Results Showing Sources of Group Variations in Performance on the Space Relations Test .....	137
8b.	Multiple Classification Analysis for Performance on the Space Relations Test Showing Subgroup Mean-Deviations From the Grand Mean .....	138
8c.	Specified Subgroup Mean Scores on the Space Relations Test Showing the Pattern of Subgroup Differences in Urban and Rural Located Schools .....	139
9a.	Analysis of Covariance Results Showing Sources of Group Variations in Performance on the Raven's Progressive Matrices .....	143
9b.	Interactions Table for Performance on the Raven's Progressive Matrices Showing Class By Residence Interactions .....	144
9c.	Specified Subgroup Mean Scores on the Raven's Progressive Matrices Showing the Pattern of Subgroup Differences in Urban and Rural Located Schools .....	145

## APPENDICES

	Page
A. Map of Nigeria Showing Former Political Regions Before The Creation of States .....	190
B. Map of Nigeria Showing the 12 States Created in 1969 .....	191
C. List of Schools Selected for the Study .....	192
D. Copy of the Letter Written to the Various Ministries of Education of the States Selected For the Study Soliciting Their Cooperation .....	193
E. - H. Examples of Replies From the Ministries Showing Their Cooperation .....	194-197
J. Copy of the SES/WCP Inventory .....	198

## CHAPTER I

### STATEMENT OF THE PROBLEM AND RATIONALE

#### Manpower Problem Facing Some African Nations After Independence

The importance of human resources in the development of a nation cannot be overstressed. Consequently, the development and effective utilization of human potential should be a major concern of any government. The developing nations, of which Nigeria is one, need educational programs which promote maximum development of their human resources.

Comparatively, very few research studies have been conducted in Africa for the purpose of improving educational programs. One of the major reasons for this was lack of psychometrically acceptable instrumentation (Irvine, 1966; Schwarz, 1963). African countries became more involved in their educational plans and programs in the 1960's which, for the majority of them, was a period of political independence (Irvine, 1966). Before this period, educational programs in Africa were mainly designed for the training and recruitment of very few natives for supportive administrative work in the colonial government administrations.

At the dawn of independence, the new African nations were faced with the problem of training and selecting skilled manpower for the development of the various sectors of their economy. Such a situation actually called for an introduction of general aptitude testing programs in both upper primary and secondary schools, as well as the use of specialized aptitude tests for the selection of personnel for specific jobs. However, at that time there were no general ability tests considered suitable for use in the developing African nations to meet this manpower challenge. For the most part, standardized ability tests developed for the highly industrialized countries were considered unsuitable for the cultures of the newly developing nations (Schwarz & Krug, 1972).

#### Efforts Made by the Nigerian Government to Solve the Problem

To find a solution in the 1960's, various African countries used the platform of the Council for Technical Cooperation in Africa South of Sahara (CCTA/CSAO) to appeal for development of tests that could be utilized to improve manpower selection procedures (Irvine, 1966). One of the outcomes of the appeal was a contract agreement between the United States Agency of International Development (USAID) and the Federal Government of Nigeria (Schwarz, 1961). Following the terms of the agreement, the American Institute



for Research (AIR), carried out a feasibility study in Nigeria to determine if the probability of devising effective testing techniques in the newly developing nations was high enough to justify the investment of a large amount of funds such a project would involve. The study revealed that the project was feasible and consequently a set of aptitude tests termed the Internationally-Developed (I-D) series was developed. These tests were validated and their use generalized to other African countries and later to some other developing nations such as Brazil, Korea, and Thailand (Schwarz & Krug, 1972). On September 1, 1964, the Nigerian Aptitude Testing Unit (NATU) was created and it inherited the I-D tests constructed by AIR. In January, 1966, NATU emerged with the West African Examinations Council (WAEC) and has been known as the Test Development and Research Unit (TEDRU) of the Council.

#### The Rationale For the Internationally Developed Tests

The I-D series include tests used for the selection of students at the end of the primary school program for further studies in secondary schools. These tests were described as "screening" tests by Schwarz (1961) who argued that the developing nations needed such tests to screen out students to whom admission into secondary schools must be denied. His rationale was that all the students

have gone through a scheme of education in which they were expected to acquire some basic skills; to further their education, he explains, those who do not possess the basic skills based on the requirements of the courses of the higher studies, and in a situation where it was not possible to provide remedial course programs, should not be admitted for further studies no matter how high their aptitudes.

Schwarz realized that such a screening test based on previous learning, has the implications of "achievement testing" which, he admits, discriminates against students who attended poor quality schools. He argued, however, that the difference between the I-D screening tests and formal achievement tests used for selections purposes is that the former screens out the bottom 30 to 40 percent of students to whom admission into institutions of higher learning must be denied, while the latter selects 10 percent or so of applicants who should be admitted. Schwarz, presumably, was referring to selection procedure in Nigeria for admitting candidates into institutions of higher learning. Selections are based solely on achievement tests given at the end of the current program of learning.

One might add that the developing nations also need

a testing program that could be used to detect the type and level of skills possessed by individual students with the aim of directing and encouraging the students to develop according to their actual abilities. It is safe to assume (except in case of extreme mental retardation), that every child possesses some level of learning ability. The crucial thing is for students to discover their actual potentials while there is still the opportunity for organizing their educational learning situations according to assessed individual capabilities. Bloom et.al. (1971) pointed out that education should be increasingly concerned about the fullest development of all children and youth and that it would be the responsibility of the schools to seek learning conditions which would enable each individual to reach his highest possible level. Certainly, not everyone may have the opportunity to attend institutions of higher learning for one reason or the other, but in an evolving culture there is the need for continued learning and adaptation through formal and informal education. Ideally, once a student discovers his aptitude it is possible for him to achieve self-actualization within his own level of ability. This means that among other things, developing nations should introduce general aptitude testing programs for counseling purposes as early as the upper primary schools, and provide adequate educational programs which

would give individuals opportunities to develop themselves. Obviously, 30 to 40 percent of a country's potential manpower is too high to be left out of a systematic development program, and to do that would lead to serious economic and social consequences such as unemployment and crimes.

#### A Constructive Role of a Testing Program in a Nation's Educational System

Anastasi (1976) defines a psychological test as "essentially an objective and standardized measure of a sample of behavior." (P. 23) She further explains that psychological tests are like tests in any other science, insofar as observations are made on a small but carefully selected sample of an individual's behavior. She likens a psychologist to a chemist who tests a patient's blood or a community's water supply by analyzing one or more samples of it. One may observe that the difference in the observational processes of these two professionals is that one works with human beings whose changes in behavior may be difficult or impossible to account for because of human characteristics, while the other works with objects that have fairly predictable characteristics. It is this idea that psychological tests measure only a sample of behavior and the fact that man is a creature of many influences

and interests whose behavior is difficult to predict that makes critics condemn the use of psychological testing as an instrument of social and economic planning. This is not to underrate the importance of psychological testing in national planning through educational programs. As far as the use of educational tests are concerned, Ebel (1963) states that the social consequences of not testing would be more harmful to a community than the adverse effects of testing. Drenth (1972) collaborates this assertion when he points out that testing has contributed to more effective use of manpower, more equal distribution of educational and professional opportunities, and to identification of talents which might otherwise remain hidden.

The fact is that the efficacy of testing lies in the type of tests and the purpose for which they are used. The use of tests as a screening agent of who should or should not benefit from social amenities, such as furtherance of education and its implications of employment and social status, should be replaced with the concept of testing as a means of giving the individual a chance to develop according to his potential. In this sense testing should form an integral part of the educational process as Dyre (1967) suggested. Achievement tests, especially those

given at the end of an educational career, would be of little or no use if all along the process no systematic attempt was made to discover individual aptitudes and thereby relate achievement to actual potential.

### A Case for Aptitude Testing in Schools

Aptitude tests provide a means of gathering relevant information for decision-making both on personal and institutional basis. It could be said that the developing nations with their limited resources ought not to leave their manpower development to trial and error. An individual may be capable of learning various tasks, but from the society's point of view some tasks have more social values than others. Some tasks also are more complex than others. Utilization of aptitude tests would facilitate the selection of those who are more likely to succeed in the jobs which require more complex skills. If this is achieved, both the cost and time of training such people would be at a minimum, and personal frustrations caused by failures are also kept at minimum. Those less likely to succeed on highly complex tasks are, similarly, detected and placed in areas where their abilities are equal to the demands of the tasks. They too experience personal success which adds to the society's well being.

In this way, appropriate use of aptitude testing can lead to the achievement of 'self-realization' as a goal of education.

Frequently, children drop out of school because they feel that the subjects they are asked to learn have no meaning for them. In most cases, the reason why they fail to see the meaningfulness of such subjects is that they are not studying for any specified objectives which they themselves are aware of. Nigerian secondary school students have no systematic means of deciding on a career. Sometimes some students settle for jobs below their actual abilities for some reasons which may include influence of expected sex-role, belonging to a low socio-economic status or sheer lack of knowledge of what their potentials are. In the same way some students may be aiming towards areas in which they are less likely to be most successful, due to family influence or misconception of their natural abilities. Either of the above cases could lead to frustrating situations later in life. In a study done at Ibadan, Nigeria in 1971 to assess the Nigerian adolescents' Academic and Occupational Aspirations, John Abiri (1977) observed that even pupils who were soon to graduate from the secondary schools were mostly unrealistic in their academic and occupational aspirations. He reported that

about 52 percent of the 1,254 students sampled expressed the desire to become medical doctors; none of the girls in the sample opted for either higher studies or professional training in an engineering field while no boy chose nursing as a career. Such situations would appear to call for an effective aptitude testing program in Nigerian secondary schools for guidance and counseling and to provide realistic goals for students to work for.

The development of human resources is not always pursued from the individuals' point of view. Often the need of the society becomes the determining factor. At a given time a society may have a shortage of special categories of manpower such as architects, engineers, or teachers. In such cases aptitude tests are used as a means to 'search for talents' for the areas where needs are felt. Under normal circumstances not all children who are academically capable attend colleges or universities for various reasons. But in times of national emergencies it is necessary to identify as many children as possible who have the aptitudes required for the specific national needs. At the present time, Nigeria appears to be in this situation. In April, 1976, the Federal Commissioner for Education, Colonel Ali, called on the Committee on University Admissions



to examine alternative means of determining admission qualifications of Nigerian students into the universities. He pointed out that the present system of admitting only candidates who pass the West African School Certificate (WASC)\* examinations in grades I or II is unrealistic and not responsive to the national needs because only very few students make these grades.

One of the problems of assessment of students in Nigeria is that there is only one recognized criterion for academic ability and that is WASC examinations performance. Theories and practices of psychological measurement demonstrate that poor examination performance could be a result of a combination of many factors among which are validity and reliability of the tests used for the examinee, the errors of measurement, and the physical as well as psychological dispositions of the examinee at the time of the test. In view of all of the above, it appears unrealistic to make one examination given at the end of five or six years period of study the only yardstick to measure a student's wealth

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\*The WASC examination is conducted by the West African Examinations Council (WAEC) to assess the achievement of secondary school students in five English-speaking West African countries including Nigeria, at the end of their secondary school programs. Levels of performance are categorized into 3 grades, i.e., grades I, II, & III. These grades correspond to evaluative terms such as very good, good, and average.

of knowledge. There should be other forms of recognized examinations, such as aptitude testing, given preferably, during the course of study to determine in what areas an individual student is naturally gifted and to guide as well as organize the educational programs accordingly. Poor performance in WASC achievement tests may be a result of irrational combinations of courses or subjects by students in secondary schools due to ignorance of individual aptitudes. Teachers' opinions and assessment of their pupils in various subjects obviously provide a form of evaluation, but there remains the fact that students' performance and attitude towards certain subjects are sometimes influenced by their individual relationship with the teachers. Thus a student may not achieve at his maximum level in a subject taught by a teacher he dislikes or who dislikes him even though he has the aptitude. Also, teachers, being human, have their sentiments and biases, and sometimes make errors of judgment due to subjective factors. In such a situation an introduction of an effective aptitude testing program could help both teachers and students get supplementary information for more reliable assessment.

### Summary

Thus, there appears to be an urgent need in Nigeria to explore a systematic means of developing the manpower resources for successful economic transformation from the subsistence agrarian level to high level technological industrialization. There is equally a pressing need to provide a means by which Nigerian students could discover their potentials so as to avoid the frustration of working either below or above one's real capabilities. Educational guidance and counseling is not yet a part of the Nigerian educational system partly because there are no adequate trained personnel to do it. When professional educational and vocational counselors are provided they would need adequate measuring instruments to accurately assess individual aptitudes.

### The Purpose of the Present Study

The aim of the present study is to investigate how to effectively utilize some aptitude tests which were developed or used in the Western culture, (i.e., advanced technology) for educational and vocational counseling in Nigeria. As a first step, the study investigates how some specified factors peculiar to the Nigerian cultural environment would affect students' performance on the selected tests. The specified factors are sex-role,

socio-economic status (SES), urban-rural residence, number of school years, and Western Culture Participation (WCP).

It is recognized that as a result of Nigeria's culture being in a transitional stage, there exists in the country various sub-groups living in different social and cultural environments. In advanced industrialized countries environmental and cultural factors are more homogeneous in the developing nations. For example, the major difference between urban and rural areas in the advanced countries is that of size of the population. Both areas have the same types of modern technological amenities. Students in different parts of such countries would be influenced by the same environmental factors. In the developing nations on the other hand, there are wide gaps between the urban and rural areas. Most of the rural areas are devoid of the modern technological objects and activities. However, there is a high degree of cross-movement of people between the urban and rural areas. For example, some students whose parents live in the cities and who belong to high socio-economic status attend boarding schools located in villages which have completely different social and cultural environments compared with the cities. Such schools were built by religious bodies who regarded

the social life in the cities either distracting or morally unhealthy for the students. Similarly, some students whose parents live in the villages and who are from low SES attend boarding schools located in the cities. Thus there exists varying degrees of "biculturalism" among the people in Nigeria.

Such peculiarities of a transitional culture makes it necessary to look at the influence of various sub-environments on performance of different types of tests. Wolf (1966) suggested that different environmental factors could, in specific ways, affect specific behavioral characteristics. There are differences between the urban and rural areas in Nigeria in terms of objects and activities which are found in each environment, also, in terms of expected sex-role in the different areas. The different environmental characteristics may affect the type and level of aptitudes developed by students who live or attend schools in these areas. Where this is the case, it would be necessary to take the environmental factors into consideration while assessing the students' potentials. The present study investigates how the urban-rural environmental factors with their implications on some social issues such as sex-role and socio-economic status affect

Nigerian students' performance on selected aptitude and general ability tests developed in advanced technological culture.

The Type and Nature of Tests Used for the Study and the Rationale for Selecting Them

The selected tests include the Raven's Progressive Matrices, and five tests from the Differential Aptitude Tests (DAT) battery, namely, the Verbal Reasoning (VR), Numerical Ability (NA), Abstract Reasoning, (AR), Mechanical Reasoning (MR), and Space Relations (SR) tests. Each of these tests is described in detail in Chapter IV. These tests have been proven to be reliable and valid in predicting academic as well as vocational aptitudes in the advanced technologically industrialized countries. It is expected that the tests could be utilized for the same purpose in the developing nations whose traditional cultures are evolving towards that in which these ability tests are developed. However, before these tests could be effectively used for predictive purposes in the developing nations, the existing cultural differences which could mar the predictive validity of the tests in the transitional culture have to be identified and taken into consideration.

The selected tests include verbal and nonverbal tests. They also include tests which can be described as

"culture loaded," (because their items reflect objects and activities typical of a technological culture), and tests which could be classified as "culture fair" (on the ground that their items consist of meaningless abstract figures not associated with any specific culture). Thus, the Verbal Reasoning, Numerical Ability, Mechanical Reasoning, and Space Relations tests which are among the selected tests for the present study can be described as "culture-loaded" tests, while the Abstract Reasoning test as well as the Raven's Progressive Matrices can be referred to as "culture-fair" tests.

Most research studies conducted in the African developing nations with European or American developed ability tests are limited to non-verbal, and tests classified as "culture-free," or "culture-fair." The fact, however, is, as instruments of educational planning, different tests serve different purposes. Non-verbal ability tests are not perfect substitutes for verbal ability tests. A Verbal Reasoning test, for example, would reflect more than an Abstract Reasoning test concepts of objects and activities of a given culture. This is why verbal tests are referred to as "culture-loaded" tests. This fact also renders verbal tests more suitable instruments for the assessment of the ability of people

from a different cultural background to perform in a given culture. It has been argued that the developing nations need special abilities to cope with technological culture, this would include ability to conceptualize different objects or activities and to see relations between them. A verbal analogy test would assess this ability better than a non-verbal analogy test. If language ability constitutes a handicap in performance on a verbal analogy test for some or all Nigerian students, it would also present a problem in their comprehension and conceptualization of those relevant objects in books or lectures. The solution would not be in boycotting verbal tests but in using them to detect and correct deficiencies. The same argument goes for other "culture-loaded" tests. This point will be elaborated in Chapter II in which the controversial issue of what type of tests should be used for vocational and educational works in the African developing nations is examined. The purpose of the present study thus determines the type and nature of the ability tests selected for the study. It also determines the nature of research methodology used in the study.



Type of Study: Exploratory Research Study

It has been explained that the purpose of the present study is to investigate how tests proven to be reliable and valid in assessing abilities in the advanced technological culture could be effectively utilized for the same purpose in Nigeria. It has also been pointed out, however, that before these tests could be used effectively for predictive purposes in Nigeria, the existing cultural and environmental factors peculiar to the present Nigerian culture, and which could mar the predictive validity of these aptitude tests should be identified and controlled. The present study is, therefore, not planned specifically for a priori hypotheses testing, but rather it attempts to explore. The idea is to generate culture-specific hypotheses which could be used as bases for future predictive research studies in Nigeria. The cultural differences between the present Nigerian culture and the Western culture warrants some caution in using specific hypotheses generated by research studies conducted in Western culture for predictive research studies in Nigeria.

Research studies conducted in Western culture have indicated, for example, that a number of social and cultural factors such as socio-economic status and sex-role affect performance in some aptitude and general ability tests in

a general predictive pattern. That is, children from high SES score higher than those from lower SES on Intelligence or general ability tests, and that boys perform better than girls in certain types of tests, and vice versa. It is possible, however, that these factors may be affected by other social factors peculiar to transitional cultures when the same tests are used in the developing nations. For example, the degree of "Western Culture Participation" may affect the influence of sex-role in the acquisition of certain abilities.

If such factors are not examined and taken care of, they are bound to confound predictive research studies conducted in the developing nations with hypotheses based on research findings in the highly industrialized countries. For the most part, the newly developing nations need a lot of exploratory and descriptive research studies to ascertain in what ways social and economic variables peculiar to their environments affect educational or psychological behavior associated with a technologically industrialized culture. In other words, the newly developing countries need to generate, through exploratory and descriptive studies, hypotheses which are valid for their present cultural and environmental situations as bases for valid predictive research studies.

## Hypotheses Testing Versus Hypotheses Generating Research Studies

Due to the peculiar situations described above, exploratory study would appear to be more appropriate in the present undertaking. Since the culture in which these aptitude tests were developed is different from the Nigerian culture in which the research study is to be conducted, efforts are to be made to discover how factors such as socio-economic status, sex-role, urban-rural residence or locations of schools, within the context of the present Nigerian culture, would affect students' performance in these tests. To initiate such a study with specific hypotheses formulated with expectations in a different culture could mean a "take off on the wrong foot" for the ultimate goal of the project. It is anticipated, instead, that the results of the study would lead to the formulation of specific testable hypotheses to be utilized both for further direct and systematic replications of the present research project, and as bases for further predictive hypotheses-testing research studies in Nigeria.

Hypotheses thus generated would represent what Overholt and Stallings (1976) described as "ethnographic" hypotheses, which, according to them are more culture-relevant and empirically grounded. They argue that the fact that

ethnographic hypotheses emerge as a consequence of a study within a given culture makes them more culture-specific. According to Overholt and Stallings, "the ethnographic hypothesis is formulated to account for phenomena which have been observed in a given culture; it is not formulated on the basis of expectations brought to that culture from the outside." (p. 13). A priori experimental hypothesis testing research study might lead to unwarranted manipulations of data by unscrupulous researchers if only to justify theories. One could say that ethnographic hypothesis would be immuned from this sort of data 'contamination' since it is the result, not the purpose, of the data analysis employed for the study.

To summarize, one would say that in an area in which there are too few research studies to generate specific hypotheses valid for experimental studies as in the present case, it would be appropriate to start off with exploratory descriptive studies based on general theories. The results of exploratory research studies could then be utilized as a baseline for specific theoretical hypotheses testing investigations. Thus, ethnographic hypotheses could be used in experimental research studies within the culture in which they are formulated. It is expected that the present exploratory study is a sort of "clearing ground" for further

research studies in aptitude and general ability testing in Nigeria. It could, for example, provide bases for validation studies which would take into consideration the cultural and environmental factors influencing the Nigerian students population when used for predictive validity studies. In any case, the purpose of a test adaptation project is a more appropriate guide for the type of predictive validity technique to be used when validating the tests on the intended population.

#### Conditions Necessary for "Relevant" Predictive Validity Studies

The validity of a test simply means the degree by which the test measures whatever it is constructed to measure. One way of checking this is to evaluate the test against a criterion. However, the type of evaluation procedure used for this depends on the type and purpose of a test. For example, an achievement test would be evaluated for the validity of its "content" against a given curriculum as the criterion. Similarly, an aptitude test would be evaluated for its predictive validity, that is the extent to which performance on the test is a measure of success or failure in a job or learning situation requiring a given aptitude. This also would involve the evaluation of scores on the aptitude test against scores on a criterion measure using some statistical techniques such as correlation or regression. However, there is more to the predictive validation of an

aptitude test than simply correlating the test scores to the criterion measure. For example, the size of the correlation coefficient, which is sometimes used as a yardstick for the validity of the test under investigation, is affected by a number of variables including the characteristics of the group on which the validation exercise is done. This is why test theorists maintain that a meaningful interpretation of a validity coefficient of a given test can only be made with reference to the group on which it is obtained and with regards to the purpose for which the test is to be used.

Aptitude tests, for example, are used for various purposes including placement, selection, and classification decisions. The difference between selection, on one hand, and placement and classification, on the other, is that in selection, an individual is either accepted or rejected for a given job or admission into a training institution, while in placement and classification exercises no one is eliminated from a given program. The purpose is to assign the individuals into appropriate "treatments" or learning situations most suitable to their individual potentials so as to maximize the effectiveness of such potentiality. In that case, placement and classification exercises are most appropriate for manpower development projects as well as student counselling for educational and career choices.

For such purposes the predictive validation of aptitude tests to be used in the projects should be person or group oriented.

The fact that aptitude tests are used for decisions which might have long reaching effects on the future of individuals has prompted some psychologists to approach test prediction exercises within the context of decision theory. This includes the use of models of prediction which would involve the interaction of individuals and the tests. The interaction principle thus implies that a test could be a better predictor for certain classes or subsets of people than the others in a given population. The implications of this is that the validity of a test for a given criterion may vary among subgroups which differ in personal characteristics such as sex, age, educational, or socio-economic backgrounds, (Anastasi 1976). According to Anastasi, Saunders (1956) termed such personal characteristic variables which make it possible to determine the predictability of an individual with a given instrument, "moderator variables" because they moderate the validity of the test. The person-orientated model of prediction differ from the classic model which assumed that predictive errors were characteristics of the test rather than of the person and that these errors were randomly distributed among persons. By linking predictive errors to the persons taking the test the interaction model

makes it possible to conduct "differential validity" studies of a battery of tests for classification purposes.

However, a person-oriented model of prediction would imply that the population in which the aptitude tests are to be used for predictive decisions be explored beforehand. In this way the differentiating characteristics of the subgroups would be identified and taken into account when conducting the predictive validity studies of such tests. The present study is an exploratory one aimed at identifying some differentiating characteristics which create subgroups within the Nigerian students population with regards to performance on the selected aptitude tests. This would lay a foundation for more relevant predictive validity studies for counselling and placement use of such aptitude tests in Nigeria.



## CHAPTER II

### REVIEW OF RELATED LITERATURE

#### Introduction

The literature to be reviewed in connection with this study are those studies devoted to a search for psychometrically acceptable tests to use for educational and vocational work in Africa. The aim is to present the trend in rationale for developing or "adapting" ability tests considered suitable for educational and personnel works among African people. The supportive arguments for suggested various types of tests will be critically examined in relation to relevant situations. Before going into this, a general classification of different types of psychological tests will be given with a brief description of each group.

#### Test Classifications

Tests could be classified in many ways. One way of grouping them would be according to what the tests measure. There are tests which measure "general ability" or "intelligence" tests, there are also those which measure specific abilities usually referred to as "aptitude" tests. Some tests are used to measure what students who have been through a program of learning are able to achieve at the

end of the program; these are called "achievement" tests. There are tests for assessing individual 'typical' behavior with regards to interests, attitude, and overall personality traits. These are usually referred to as "inventories."

### Intelligence Versus Aptitude Tests

Both intelligence and aptitude tests are described as "mental ability" measures, but the difference lies in the type of abilities they measure. Cronbach (1970) described intelligence tests as those which measure such mental abilities that are valuable in almost any type of thinking. He argues, however, that the name "intelligence tests" is misleading in view of the fact that "intelligence" has many meanings. In contrast to the tests of "general ability" there are those which measure "specialized" abilities such as mechanical comprehension, finger dexterity, sense of pitch, etc. In Cronbach's view there is no widely used name for these sort of tests, but Mehrens & Lehmann (1975) refer to such tests as "aptitude" tests. They observe that some test constructors use the two terms "intelligence" and "aptitude" interchangeably but some feel that there are some subtle differences between them.

One such distinction is the type of measure(s) obtained by using the test. An intelligence test yields a general measure, usually the Intelligence Quotient (I.Q.)

which is regarded as a measure of an individual's ability level at a given point in time, in relation to his age norms (Anastasi 1976). An aptitude test or battery of tests on the other hand yield specific or multiple measures of specified factors. Another distinction which some test constructors make between intelligence and aptitude tests is with regards to the role of "heritability" and "environmental" factors on cognition of the test items. Mehrens & Lehman (1975) explain that test constructors who feel that performance on their tests is influenced more by "inherited" ability and less by environmental contacts tend to label such tests "intelligence" tests. Those constructors who do not want to get into the entangled argument of quantitative contribution of "nature" or "nurture" on test performance prefer to label their tests as aptitude tests. Thus it appears that the terms "intelligence" and "aptitude" as used by test constructors may depend on what each test constructor has in mind as he builds the test, not necessarily what he succeeds in "achieving" with it with regards to assessment of "intelligence" or "aptitude."

### Achievement Versus Aptitude Tests

At the end of a course or training program, subjects are frequently tested to assess how much they have assimilated from the learning materials. The tests used for this sort of assessment are based on the type of materials used for the program and are generally referred to as "achievement" tests. Theoretically, aptitude and general intelligence tests are said to be used for predicting what an individual could do in the future while achievement tests measure past accomplishment. However, past achievement can also be used to predict future performance in certain situations. One distinction that could be made between general intelligence and aptitude tests on one hand, and achievement tests on the other side is that the former measure "informal" learning while the latter measures "formal" learning.

### Personality, Attitude, & Interest Inventories

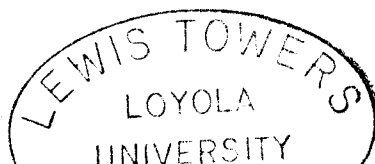
Cronbach (1970) grouped all measures of individual "behavior" whether of "interest," "attitude," or general "personality" traits as tests of "typical performance." These tests according to him are used to investigate not what the person "can do" (which is his ability) but what he actually does (i.e., his typical behavior). Interest in "personality" assessment grew from the same reason that led to assessment of "intelligence," namely, curiosity about

individual differences. Personality is assessed by use of questionnaires or inventories which prompt the subject to give a self-report of himself. Another method is to observe the subject's behavior in a defined situation. Some clinicians and researchers use "projective" techniques to assess subject's personality. Projective tests require the individual to interpret objects which are usually in the form of pictures, diagrams, incomplete sentences, drawings, etc. From his interpretations the researcher assesses a "projected" personality.

#### What Type of Tests Are Psychometrically Acceptable For Use in African Developing Nations

Psychometric measurement is a feature of the advanced technological countries. It is an outgrowth of "modern science." Consequently, all psychological tests originated within the technologically industrialized culture. The tests were used for clinical, vocational, educational, and research work. Contacts between the Western advanced industrialized countries and African countries during the exploration and colonial days led to the introduction of "Western" culture into Africa. This included the establishment of Western institutions such as the church, schools, hospitals, modern industries, etc. Along with these came the need for "measurement" for scientific solutions of problems in these institutions.

The problem of finding suitable tests to use for educational and manpower development works in African countries has generated a great deal of discussion as well as some research works in various African countries. As was pointed out in Chapter I, the 1960's brought in an era of dire need for psychological tests in Africa to assess educational and industrial skills for predictive purposes. Earlier research works such as those of Fick (1939) and Biesheuvel (1943) among others, were more of a comparative nature. That is, the psychologists tried to classify and compare persons from diverse cultural backgrounds along the same trait dimensions such as intelligence or personality. (Irvine, 1966). Dague (1972) observed that the traditional personality and classical tests of mental development used by some of these type of researchers to classify African children along these psychological attributes fail to elicit valid responses among the African subjects because the tests contain items which subsume scenes and ideas that are foreign to the African culture. He further noted that language differences complicate the problem. Even when attempts are made to modify the items by translating them into the local languages or redrawing the pictures to reflect local African arts as Ombredane (1969) did with some items of the Thematic Apperception Tests (TAT) in



the Congo, Dague explained that the effect was not specifically different from that produced by the original items.

One would not be surprised at this sort of situation considering the fact that most of the traditional personality tests, e.g., TAT, as well as some classic intelligence tests such as the Stanford-Binet type, contain items whose responses require subjective interpretations. Some of these items call for opinions or stories about pictorial scenes or suggested social issues, and subjects' responses usually vary from culture to culture according to social values and local customs or traditions. The issue is further complicated by the purpose of some of these research studies requiring the use of these tests, as when, for example, anthropologists seek to explain the genetic and/or environmental differential effects on development of "personality" or "intelligence" across cultures. Such inter-cultural comparisons in terms of development of psychological traits often necessitates the use of the tests in their original versions, and this usually raises problems of "construct validity" with regards to cultures different from those in which the tests originated, especially for constructs, such as 'personality' and 'intelligence,' that lack standard operational definitions.

Due to the problems raised by these basic sort of cross-cultural research, plus the fact that the developing African countries urgently need tests for educational and vocational counselling and planning, emphasis is shifting to applied and intra-cultural studies within African countries. One of the major aims is to find tests which will assess the potentials of individuals in the developing nations to cope with the cultural demands of modern science and technology towards which their traditional cultures are moving.

The Concept of "Adaptability" as a Suggested Alternative For Tests of General Intelligence Among Developing Nations

Various researchers have approached the achievement of these objectives in different ways and with varying rationales. At the National Institute of Personnel Research (NIPR) in Johannesburg, Biesheuvel and his colleagues felt that the concept of 'intelligence' is identified "with that which makes for success in the Western culture" (p. 51) and that it has no standard operational definition. They therefore maintain that what the developing societies need are tests which radically depart both in concept and administrative procedure from the fundamentals of the classic "intelligence tests." For this purpose they came up with the concept of "adaptability" which according to Biesheuvel (1972) underlines the General Adaptability



Battery (GAB) constructed by his group in 1950. The GAB consists of a series of "performance-tests" and was used for selection of illiterate African mine-workers in Johannesburg.

Biesheuvel (1972) described 'Tests of Adaptability' in general as tests which measure potential to meet educational, vocational and social demands. The concept of 'adaptability' according to him, is an essential characteristic of all behavior. Unlike "intelligence," "adaptability" explained Biesheuvel, is not a construct which can be factorially defined, nor is it an attribute or a trait. He further argued that adaptability has close affinity to culture because culture is "the embodiment of man's past adaptations to his environment, transmitted to successive generations with such new developments as changing circumstances demand" (p. 51). The key factor in the concept of adaptability is "ability to learn;" therefore, advised Biesheuvel, an adaptability measure must provide opportunity to learn how to solve the test problems, and that the content of the instrument is to be chosen according to what the individual has to learn or adapt to. In his opinion, adaptability testing would not, like the conventional testing programs, raise the problem of conceptual distinctions between intelligence, aptitude and achievement tests, nor would the concept call for the controversy over the quantitative

contribution of genetic and environmental factors. This is because both cognitive and non-cognitive elements are assessed by adaptability measures.

One might observe here that the concept of "adaptability" as described by Biesheuvel seems to raise some conceptual distinctions between it and that of 'aptitude,' at least as defined by Bingham for Warren's Dictionary of Psychology. According to this definition, aptitude is "a condition or set of characteristics regarded as symptomatic of an individual's ability to acquire with training some (usually specified) knowledge, skill or set of responses such as the ability to speak a language, to produce music..."\* (The underlining is mine.) Defined in this context, the concept of aptitude, like that of adaptability, connotes "trainability." In this sense it has not subscribed to the idea of "innate ability" or quantified "heritability" which some intelligence theorists like Jensen (1969) adhere to. On the other hand, the fact that adaptability is concerned with learning whatever one's culture demands him to know, does not make the learning as specific as in aptitude testing. Besides, some of the tests recommended by Biesheuvel as good measures of adaptability such as the

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\*Quoted in the DAT Manual, 1974, p. 2.

Raven's Progressive Matrices (RPM), and the Koh's Blocks, could be described as measures of "general intelligence;" at least it is said that the RPM is saturated with the Spearman's 'g' up to a level of 82 percent (Raven, 1975). This point raises a problem of a conceptual distinction between the concept of 'adaptability' and that of 'general intelligence.'

The notion of measuring the total behavior as an adaptive measure, as expressed by Biesheuvel, may not be as unique to adaptability testing as he seems to suggest. According to him, "intelligence testing demands that cognitive functions be the principal if not the only source of variance in the test results." (Biesheuvel, 1972 p. 52). However, Wechsler (1975) who could be considered as one of the "fathers" of intelligence tests, drew the attention of psychologists to what he described as "accumulation of evidence" that intelligence cannot be equated to cognitive or intellectual ability. He explained that much as intelligent behavior might sometimes call for ability to reason or some other intellectual functions, that, at other times, the behavior might call for actions which connote traits such as drive, persistence, and goal awareness. These he designated as the 'nonintellective' factors of intelligence.

Dague (1972), subscribing to the idea of adaptability testing, expressed the opinion that "capacity to learn in new situations" is a more appropriate thing to measure among African people in view of the fact that Africa is in a transitional stage. He is, however, less optimistic than Biesheuvel as to how this is to be done. He does not support the idea of 'culture-fair' tests in which the materials are to be drawn from the individual's everyday life experience. This, he argues, would look like the individual is encouraged to maintain the 'status quo.' He is equally not in support of standardizing the traditional tests for the African norms because he feels that this would call for revision of the norms constantly as the culture changes. The 'culture-free' tests like the Raven's Progressive Matrices (RPM), according to Dague, has not proved a success either. In the first place, he doubts if such tests are as culture free as they are attributed to be. He cited cases of research with the RPM among which are those of Laroche (1956), Ombredane (1957), and Laurent (1963), in which it was discovered that the test distinguished sharply between educated and uneducated persons of the same age, and that scores were proportional to number of years of schooling. Even testing with the reputed Cattell Culture Free Test (Xydias, 1960) produced the same results. Thus Dague points out that literacy is a cultural factor affecting performance of the so called 'culture-free' tests.

Dague also described some attempts made by researchers to measure "learning potentials" or "educability" in terms of "gain scores." Some examples are those of Laroche (1959) who tested Congolese 10-14 year old children with the RPM, also Ombredane, Robaye and Plumail (1956) who used the same test for a group of Kasai people. The practice was to administer the test several times over, after some familiarization exercises, to the individuals on different occasions, and record their "gain-scores" from trial to trial as a measure of their 'educability' or 'adaptability.' It was found, however, that such measures correlated poorly with school work. These findings made the researchers doubt the predictive ability of "gain-scores." They also found that "gain-scores" were directly proportional to number of years of schooling. This makes Dague conclude that 'educability' might in part be a function of previous schooling.

If this is true, one may then observe that 'educability' or 'adaptability' testing has not proved to be the novelty it is meant to be, for both the concept and its procedure, as so far prescribed by its advocates, will not free the African psychologist or educationist from the Western concept of "ability to learn." More so as most of these African countries have school systems and economies that are patterned according to those of the Western countries.

What the individuals have to learn or 'adapt to' are skills necessary for survival in a technologically industrialized culture, which is the culture of the Western countries.. In that case, what they need is the very thing "which makes for success in the Western countries" which is Biesheuvel's (1972 p. 51) idea of "intelligence."

Van der Flier (1972), like Biesheuvel, defines "intelligence" as a concept that covers those "mental abilities that predict success in Western institutions" (p. 448), but unlike Biesheuvel, he sees no harm in testing for intelligence in the newly developing countries since psychological tests for selection purposes in these nations are restricted to "westernized Institutions," such as education, the army, industries, and so forth.

#### Test Adaptation: A Solution to the Problems of the Developing Nations

Definition: Those who share Flier's line of reasoning recommend that the problem of the developing countries could be solved through "test adaptation." Test adaptation can be described as a process of using tests developed in one culture for measuring some psychological attributes for the same purpose in another culture with some modifications. The modifications take various forms ranging from changing the administrative procedures of the tests, (such as the timing and the amount of practice exercises)

to more significant changes like translations or reconstruction of the items of the tests to reflect local situations. The extent of the modifications in any situation would depend on the purpose and nature of the test.

Rationale: The rationale for adapting aptitude tests, for example, is, as Schwarz (1961) observed, that skills required for certain jobs, such as carpentry, are the same irrespective of where the job is carried out. Also, Schwarz and Krug (1972) explained that a test rationale is the logical relationship to the "real-life" skill that a test is to measure. This would be in operation when an aptitude test constructor, for example, first analyzes the skills required for success in a job by identifying them in those already successful in that job. He then constructs test items which duplicate these skills for selecting individuals who are likely to succeed in such jobs. Schwarz and Krug pointed out that most European and American standard aptitude tests are constructed on such a rationale, and that the same rationale is equally applicable to the developing nations.

Should the Developing Nations Reconstruct the Items of Western Developed Ability Tests to Reflect Existing Conditions in their Traditional Cultures?

Schwarz and Krug (1972) are of the opinion, however, that much as the basic job skills are the same irrespective of where they are performed, that the real test exercises (which would sample the possession of these skills by individuals who are to be selected for the jobs) should be modified to reflect the local conditions existing where the job is to be performed. This was the guiding principle for the construction of the Internationally-Developed (I-D) aptitude tests which Schwarz and his AIR colleagues developed in Nigeria within the period of 1961-1963. The general method was to reconstruct the items of standard European and American aptitude tests to reflect the existing environmental conditions in Nigeria at that time. They also modified, to a large extent, the administrative procedures of the standard tests to suit local cultural habits, and tempo of life.

Schwarz and Krug (1972) later reported that test adaptation in the nature described above may be effective in selecting the "most able" of the applicants in the adapting country, but that those selected may not be ready for a "standard course" or training on modern science and technological jobs. They illustrated this point with the



Adaptation of the I-D Mechanical Information test.

According to them, the items of this test were based on "technical phenomena that are readily observable in rural Africa." (p. 18) That would mean the natural scientific occurrences that form parts of the people's daily activities, such as kindling of fire and boiling things over the heat, as well as the process of fashioning the local implements and building houses. They went on to explain that it cannot be readily determined how the best of the African applicants as identified by this test (I-D Mechanical test) compare in Mechanical ability with the best of the American applicants as identified by any of the standard Mechanical aptitude tests. They stated, "...while an African who can answer a test question about an oil lamp may show as much basic aptitude as an American who can answer questions about an electric light, he (the African) will operate under considerable handicap when he enters a course in which electricity is the topic of instruction." (p. 18) Schwarz and Krug further explained that an individual whose background is such that he cannot answer questions on gears or pulleys when they appear on a test paper, will find it difficult to cope with such subjects when he encounters them in a text book or a lecture. They therefore suggested that in a situation like this, the curriculum should also be adapted to reflect local conditions. The

authors criticized what they described as the usual practice in the developing nations whereby students are selected for higher studies with tests whose items are based on local conditions, but then are subjected to an "imported curriculum." In their opinion, the students may not benefit from such courses because they are not ready for them.

Changing the test items of a standard test to reflect local conditions in the developing nations, and adjusting the curriculum accordingly, as Schwarz and Krug suggested would amount to a retrogressive policy on the part of the developing nations. It would mean, for example, that instead of the mechanism of electric lights, that of the oil lamp should be taught in post-primary/secondary institutions where tests constructed on the reasoning behind the I-D Mechanical Information test are used to select students for further studies or training. Besides, it is more than a decade since Schwarz and his colleagues developed the I-D series. The educational as well as the economic goals of the newly developing countries have changed considerably.

Nigeria, for example, has abandoned the idea of viewing herself as primarily a producer of raw materials which are to be processed and sent back to her as manufactured goods by the developed countries. Besides being a supplier

of primary produce, she is also establishing manufacturing industries within the country to process some of the raw materials. At the same time the agricultural sector is being mechanized. In the field of education emphasis is on science and technology. This fact is reflected in the country's recent educational policy which abolished all forms of fee-paying in technical schools while the grammar schools are only partially free. In his New Year Message (January, 1977) to the nation, the Head of State noted, among other things, that one of the immediate tasks of the government is to transform the society technologically. All these measures serve as a pointer to the fact that Nigerian culture is evolving from that of a traditional agrarian community into a technologically industrialized society. If, therefore, Nigeria is to be able to sustain the new culture without remaining a "perpetual importer" of scientific and technological know-how, she has to re-orientate the thinking of her future generations by stimulating them with the objects and activities that are typical of this new culture. This will enable Nigeria not only to adapt to the cultural demands of a technologically industrialized society, but also to improve on it for future generations.

The curricula to bring about this technological transformation of the society have for some time been imported, and will continue to be imported at least in the near future. The reason being that the new culture is not part of the society's traditional culture. Developing nations have to borrow the basic ideas from the technologically advanced countries; with specializations later on they could improve on the basic ideas. Schwarz and Krug (1972), realizing this fact themselves added that in the end it is the purpose of the testing proposal which would decide the extent of adaptation of an aptitude test. They agreed that if the objective is to use imported curricula with standard instructional materials at established rate of speed, it would be a waste of time to develop special tests which are considered culturally appropriate.

One could, on the same note, thus observe that, since the developing nations operate Western system of education with imported curricula aimed at transforming the traditional agrarian culture into that of the technologically industrialized societies, they should use Western-developed tests designed to assess abilities in terms of a technological culture for that purpose with little or no modifications. This could, in addition to assessing the students' development of the appropriate abilities necessary for successful technological transformation of their traditional

culture, provide a means by which each developing nation could assess her level of technological development at a given period of time.

Studies Which Used Western Developed Ability Tests in Their Original Forms in Nigeria

Following the line of reasoning discussed above, some researchers in Nigeria have explored the possibilities of adapting with little or no modifications, some general intelligence tests developed in the Western countries. Yoloye (1965), for example, studied the concurrent validity of the Lorge-Thorndike Intelligence tests with grades on teacher-made tests in nine secondary grammar school classes in Ibadan, Nigeria. He obtained validity coefficients that ranged from .25 to .62. He attributed the wide range of variations to the quality and marking of teacher-made tests from school to school as well as from class to class. He felt, therefore, that a more reliable criterion would give a better spread. To this end, he chose the West African School Certificate (WASC) examination results. The WASC examination is set and marked solely by the West African Examinations Council (WAEC) and it is taken by all secondary school students in Nigeria as well as in other English-speaking West African countries.

To a sample of 150 students drawn from three secondary Grammar schools in Ibadan, Yolooye administered the

multi-level edition of the Lorge-Thorndike Intelligence Tests, both the verbal and the non-verbal batteries, in their first and fifth years in school. At the end of the fifth which also is the final year, the results of the WASC of 70 students available out of the original 150 in the sample were correlated to their IQ and Raw scores on the Lorge-Thorndike Intelligence tests. Contrary to the expectation of the researcher, the IQ scores correlated higher with the WASC results than with the Raw scores in both classes one and five. It was observed that for class one the Non-verbal (NV) battery proved a better predictor with  $r=.48$  than the Verbal (V) battery which gave  $r=.38$ . In class five, on the other hand, the verbal battery gave an  $r$ -value of  $.62$  while the NV battery gave an  $r$ -value of  $.45$ . Yoloze (1973) attributed this result to the difference in the English language competency between the two classes. Yoloze pointed out the fact that the technical manual for the I-D tests, which were developed and standardized on Nigerian children, reported concurrent validities ranging from  $.56$  to  $.64$ . This fact, he observed, indicates that the Lorge-Thorndike Intelligence tests would possibly predict school achievements as well in Nigeria as the I-D tests.

Bakare (1972) investigated the effect of social-class differences in the performance of Nigerian Primary school children on the Draw-A-Man (DAM) test by Goodenough-Harris. His aim was to examine the validity of the test for Nigerian children and to provide local norms. He administered the test to 393 Nigerian children and 106 non-Nigerian (American and English) children attending schools in Nigeria. Two hundred and four of the Nigerian children were from upper-class homes, while 189 were from lower-class homes. He determined social class from father's educational level.

His results showed social class differences. He observed that there was no significant difference between the performance of the Nigerian upper-class children and the non-Nigerian children. Bakare attributed the SES difference to lack of a stimulating environment and malnutrition on the part of the lower class Nigerian children. He concluded that the predictive function of the test would be marred by its social class discrimination, and suggested that including the test in a battery of tests with some verbal components might improve its predictive value among Nigerian children. The fact that the DAM test, which is a non-verbal test, discriminated among children from different social groups made Bakare wonder if there would be any hope of finding a "culture-free" test. He doubted

if the Raven's Progressive Matrices would be any better.

### The Impossibility of Constructing a Culture-Free Test

Bakare's (1972) surprise that performance on the DAM test was affected by social class differences and consequently his "despair of ever finding a culture-free test" (p. 362), is no doubt the result of Phatak's (1959) observation, (reported by Bakare) that performance on the test is not "appreciably influenced by artistic talent or by training." It has to be pointed out, however, that a review by Dennis (Ihsan & Dennis, 1970) of several research studies conducted with the Harris-Goodenough DAM test pointed to the conclusion that performance on the test is a measure of experience with some form of representational art whether native or imported. Dennis observed that research studies conducted in over twenty societies in various nations show that average I.Q., as assessed with the DAM test, varies from about 51 to 125 depending on whether the society in question has an indigenous representational art, or has at least imported some modern arts through contact with Western culture. In some societies children were tested more than once, before and after Western contact. Dennis explained that in those societies where native representational art did not exist, the DAM test is a measure of the degree of "Western Acculturation."



This would include the children's experience with newspapers, magazines, cartoons, television, and moving pictures. According to Dennis (1972) and Anastasi (1976) Goodenough and Harris themselves have agreed that the fact that a test is non-verbal does not make it "culture-free," and they have expressed the opinion that "the search for a culture-free test, whether of intelligence, artistic ability, personal-social characteristics, or any other measurable trait is illusory." (Goodenough and Harris, 1950 p. 399). Anastasi (1976) also observed that the findings with the DAM test are typical of results obtained with all tests initially designed to be "culture-free" or "culture-fair."

The concept of culture-free tests is an outcome of early works in cross-cultural testing. Anastasi (1976) explained that the early psychologists who championed the development of instruments for cross-cultural testing at the early part of this century hoped that "it would be at least theoretically possible to measure hereditary intellectual potential independently of impact of cultural experience." (p. 345) It was in the pursuance of this objective that the concept of "culture-free" tests was invented. The idea was to construct tests, performance on which would not be influenced by learned experience from any specific culture, but by innate reasoning capacity. An example of such a test is the Raven's Progressive Matrices which,

Raven (1975) explained, was constructed "on the a priori assumption that if Spearman's principles of neogenesis were correct, it should provide a test suitable for comparing people with respect to their immediate capacities for observation and clear thinking." (p. 1) Some research studies, however, have shown that neither the Raven's Progressive Matrices nor any of the other tests constructed on the same assumption have proved to be "culture-free."

It is not surprising, however, that test constructors have not been able to produce a "culture-free" test. Some psychologists, e.g., Anastasi (1964, 1976) argue that tests are instruments to sample behavior and that a man's behavior reflects the cultural background which produced him, hence it seems futile to attempt to construct a test that would be "culture-free." Anastasi explained that what test constructors have attempted to do so far has been to construct tests which would rule out some parameters on which cultures differ. Such parameters would include language and literacy, for example. Usually it is assumed that the items of such tests would not give advantage to subjects from any one specific culture. That is, they consist of either abstract meaningless figures or the items are objects considered common to all cultures such as "man." In this sense these tests could be said to be "culture-fair"

or "culture-common." Even at that, as Anastasi pointed out, it is almost impossible to get a test which would be "fair" to more than one cultural group. She explained that there are as many varieties of "culture-fair" tests as there are parameters in which cultures differ.

#### Effective Utilization of Western Developed Aptitude Tests in the African Developing Nations

The culture "fairness" or "unfairness" of a test would seem to depend on what a particular test is measuring. A non-language test which measures space perception of 3-dimensional objects, for example, would not be "fair" to subjects whose cultural demands do not support the development of such ability. Berry (1972) observed that the development of "spatial-perceptual" skills is a function of ecological demand and cultural support. He arrived at this conclusion after comparing and contrasting some 'traditional' and 'transitional' cultures on their performances on some tests which measure this ability. The tests include Koh's Blocks, Matrices, and tests of Embedded Figures. Incidentally, these tests are among those usually referred to as "culture-free" tests in cross-cultural testing. All these findings support Ferguson's (1954, 1956) observation that cultural factors prescribe what shall be learned and at what age; consequently, different cultural environments lead to the development of

different patterns of ability. Anastasi (1976) pointed out that cultural differences become cultural handicaps when individuals move from the cultures in which they were reared to function or succeed in a different culture. She remarked that, however, this should not mean a recommendation for cultural isolation no matter how comfortable it is for individuals. Advancement of civilization necessitates cultural contacts and interchanges between cultures. On this ground one might add that one of the main objectives of cross-cultural testing should be to assess and encourage the advancement of technological industrialization. In that case, the focus would not be on "culture-free" or "culture-fair" tests but on how to use efficiently, various ability tests developed in advanced technological countries to detect and encourage the development and growth of those abilities in subjects whose traditional culture is evolving towards technological industrialization.

To achieve this objective, exploratory research studies are needed to be conducted in the developing nations. The aim of such studies would be to identify cultural and environmental factors specific to a transitional culture which could affect the predictive validities of Western-developed ability tests if uncontrolled for. The present study is planned for that objective. It has been pointed

out in Chapter I that the developing nations need research studies which would enable them to utilize all their available manpower. Such studies, it was said, should approach aptitude predictive studies from "placement" and "classification" point of view, rather than from "selection-rejection" objective. It is argued that the transitional nature of the culture of the developing nations could create a subgroup of students which differ on identifiable cultural and environmental characteristics peculiar to the culture. In that case efforts should be made to identify such subgroups and then conduct predictive validity studies aimed at finding effective "predictors" for various subgroups on a given criterion depending on the characteristics of the subgroups in relation to the criterion.

### Recapitulation

In this chapter, the trend of suggestions and arguments for the type of tests which should be used in African developing nations has been reviewed. It is argued that if the idea behind "adaptability testing" as described by Biesheuvel (1972) and his colleagues is to assess the individual's ability to cope with the demands of his culture, that more suitable tests would be aptitude tests developed and validated in the culture towards which the traditional African cultures are moving. It is this new culture that the subjects have to adapt to. In that case, it is

suggested that research studies should be aimed at finding an effective way of using such tests among the Africans. For example, the present study is aimed at examining what factors would lead to group differences in performance of Nigerian students on aptitude tests developed in Western culture. This paper maintains the view that assessment of the ability of children in the developing nations in terms of objects and activities typical of their changing traditional culture would not yield a very reliable measure of the individual child's abilities to cope with the demands of the technological culture. And instead of changing the curricula used in schools in the developing nations to conform with "ability" tests measuring skills in terms of their traditional culture as Schwarz and Krug (1972) suggested, it is recommended that "imported" ability tests be used to assess students' capabilities to cope with relevant "imported" curricula based on the Western technological culture.

In that case, it is argued that a search for a "culture-free" test may not be the answer to the problem of the developing nations. Besides the fact that the concept of a "culture-free" test is not a reality in view of the fact that tests are samples of behavior and behaviors are products of specific cultures, a "culture-free" test, if there is such a thing would not be effective in the assess-

ment of people's abilities to cope with the demands of a given culture. For such an assessment one needs tests which reflect the characteristics typical of the target culture.

However, the differences between the African nations' traditional cultures and that of the advanced technological societies necessitate an investigation into the possible effects of peculiar environmental and cultural factors, in a given transitional culture, on the performance of students on the type of ability tests described above. The findings of such investigations would be used for effective utilization of Western-developed aptitude tests. Accordingly, the present study is planned to investigate the possible effect of specified cultural and environmental factors, such as sex-role, socioeconomic status, Western culture participation, urban-rural location of schools or residence, number of school years, and students' boarding or non-boarding status, on Nigerian students' performance on selected tests from the Differential Aptitude Tests (DAT) battery, as well as on the Raven's Progressive Matrices. The next Chapter elaborates more on the peculiar characteristics of the present Nigerian culture.

## CHAPTER III

### DEVELOPMENT OF SOCIOECONOMIC STATUS AND WESTERN CULTURE PARTICIPATION INVENTORY

Purpose: In line with the planned study, it was necessary to develop some instruments to assess the selected cultural and social factors peculiar to the present study, such as socioeconomic status and Western culture participation within the context of the present Nigerian culture.

#### Socio-economic Status and Its Cultural Implications

Like other social factors, SES is defined and measured in various ways in different cultures according to the social climate existing within a given culture. In the highly industrialized countries, economic operations in all sectors are fairly stabilized and both the urban and rural areas are developed in terms of modern amenities. Also the bulk of the society work in industries or earn wages under a fairly unified wage system and condition of work. In such cases, entry qualifications for certain categories of jobs would be standardized to some extent. Also under such conditions educational level or occupational group of a father may be a good index for socio-economic



background of a child. In the developing nations, on the other hand, (Nigeria, for example) economic opportunities depend more on political and social favors than on experiential merits. In addition there are large gaps in income, and, living conditions for workers in the same job categories may also differ depending on where and for whom one works. Besides, only a small percentage of the people are employed in industries and earn wages while the majority are self-employed farmers and traders. Under such circumstances a more realistic measure of SES would be a composite index which is a result of combined scale scores on a number of factors related to the measured factor. An index could be described as any measure which combines the values of several variables or items into a composite measure. They are generally used to assess some underlying continuum which can only be measured partially by any single item or variable which is included in the index. (Nie et. al. 1970 p. 529). In the present case, each item is related to the factor being measured but, each by itself would not provide a reliable measure for the factor due to a number of other operating factors some of which have already been discussed. In that case, if responses on a single scale are unreliable, the combined composite index would provide a measure of considerable reliability.

### The Construction of SES Index

The SES index is computed from the first part of an inventory (Appendix J), developed to measure a student's overall home and modern cultural background. The first six items of this part of the inventory ask for general information such as class, sex, location of schools, parents' place of residence, and whether one is a Boarder or Day student. Items 7-13 ask for information on factors which indicate the social and economic background of the student's family. These include parents' level of education, income, and type of occupation.

Each of the SES items has a number of categories arranged in a hierarchal order and keyed accordingly. For example, Father's and Mother's Levels of Education has each seven categories ranging from "No schooling at all" to "Post-graduate education." "No schooling at all" earns one point while "Post-graduate education" level earns seven points. The maximum total score for a student on SES scale is 38 and the minimum score is five. A student's SES is computed by summing up his scores on the various items. The fact that the items are related provides a means of checking the consistency of students' responses. For example, items 9-12 are all related to income and a response on any of the items provides a means of cross-checking responses to items on education and occupation.

The same strategy is used to check the internal consistency of the whole inventory.

Western Culture Participation: Rationale Behind Its Inclusion  
In The Specified Independent Variables

The present Nigerian culture could be described as "Biculturalism." This implies that the majority of the people live under the influence of two distinctive cultures. At the extremes, some people's behavior is stimulated largely by the traditional cultural environment while other's behavior is affected more by the modern culture. However, between these extremes, the majority live under the influence of the two environments on varying degrees due to high level of inter-dependence between the urban and rural areas. For example, most people in the rural areas send their children to boarding schools in the cities; similarly, some parents who live in the cities send their children to boarding schools built in the rural areas (especially those built by Religious Bodies) for moral and religious reasons.

With regards to Nigerian students' performance on aptitude tests developed in Western culture it is expected that one's level of Western acculturation in terms of familiarity with technological objects, would affect his performance on these tests. As a result of the existence

of "biculturalism" in Nigeria it is possible that this Western acculturation exists in varying degrees in individual students. Since the home is not necessarily the only source of Western-culture-contact for Nigerian students, the degree of individual Western acculturation would depend on a number of other things such as mobility, curiosity, interest, among other things. In that case, the effect of other factors under investigation in the study, such as School Location, Residence, and Sex-role, even that of socioeconomic status, might be blurred.

It becomes necessary, therefore, to control the effect of individual degree of informal interaction with technological objects substantively by measuring it out as a separate factor and to hold its effect constant while assessing the effect of the other factors. In that way the sensitivity of the other factors to performance on the different tests would be increased.

#### The Construction of the Western Culture Participation Index

Part II of the inventory measures WCP. It is divided into two sections, A & B. Section A lists 31 objects, some or all of which could be found in any modern home. For each object, a student is to indicate (1) if the object exists in his home, or (2) if the object does not exist in his home but he knows what it is and what it is used for, or (3) if he does not know what the object is. A student

who indicates (1) earns 4 points, one who indicates (2) earns 3 points and one who indicates (3), no point. The rationale in the keying of this section is based on the assumption that a student who has an object such as a radio in his home would know more than one whose family has no radio, about where and how to locate a radio station, or how to regulate the volume, or the work of an aerial, etc. On the other hand, a student whose family has no radio but who has seen a radio set would have more knowledge about its make-up and use than one who has never seen a radio. Maximum number of points obtainable in this section is 124, and the minimum point is zero.

Section B of this part of the inventory also lists a number of objects and activities which could be seen in various places in an urban industrialized area. Some of the items such as attending a private Nursery School, and taking piano lessons outside school hours, are used to check the internal consistency of the students' response and thus the reliability of the whole inventory. The items in this section are the Yes/No type, depending on whether a student has seen the object or visited a place, or taken part in a certain activity. A response of 'yes' earns 2 points while that of 'no' earns no point. Maximum number of points on this section is 62, the minimum is zero.

### Validation of the Socioeconomic Status and Western Culture Participation Inventory

Type of Validation: The aim of the validation exercise was to find out how the SES items would discriminate between students from typically low and high SES groups, and how the WCP items would discriminate between children exposed to modern technological environment and those under the predominant influence of the traditional culture, that is, those with little or none of the modern technological objects or activities around them. For this purpose an effort was made to get "criterion groups" through the use of a stratified random sampling technique. It could thus be said that the inventory was given a "content" validation, in that the "contents' discriminations" are checked against the associated factors.

The inventory was validated in Lagos State. Lagos is the capital of Nigeria, and at the same time it constitutes a State by itself, (see Appendix B). As a capital, it attracts people from all over the Federation as well as from outside the country. There are many and various types of secondary schools in Lagos owned and run by various agencies including the Federal government, the Lagos State government, various Religious Bodies, communities, private firms and companies. Lagos State has both urban and rural sections, and contains people of all classes of work and life.

Sampling Procedure and the Sample: Schools in

Lagos State were divided into two categories according to location, i.e., urban and rural. Within each category, schools were grouped according to 'grade.' The 'high grade' schools are those rated as "good" from their WASC examination performance. Usually the bulk of the student population in such schools have some high stimulating home and environmental background which would be a combination of many factors. Similarly, the 'average status' schools contain students from moderate stimulating environments. In the rural area the schools are grouped according to whether they are established by the local communities in which case majority of the students would be from within the local area, and these are usually children of the local farmers and petty traders. Or the schools are established by agencies such as the government or religious bodies, in such cases the students are usually a cross section of the surrounding community as well as from the urban areas.

Having stratified the schools under the headings defined above, a random sampling (lottery method) was done within each strata. Six schools were thus selected, three from the urban area and three from the rural area. The schools are, Igbobi College, Holy Child College, St. Finbar's College, from the urban area; others are Imota Community Grammar School, African Church High School,

Ifako-Agege, and Girls Secondary School Gbagada.

Students in Classes III & IV were used. The reason was partly because the study was done during the last term (March-June) of a school year, 1975-76. At this time of the year the class V students were busy preparing for the WASC examinations. Also, the major study was scheduled for the first term of the next academic year (September-December), 1976-77, and the target population was students in classes IV & V who were the same as those in classes III and IV in the 1975-76 academic year.

Instrumentation: The Inventory was administered to 250 students selected randomly from classes III and IV between March and April, 1976 in the above mentioned schools. The author read through the items and explained them while the students made their responses. They were encouraged to ask questions, and some proctors assisted in showing them what to do.

Scoring: The responses of the students were coded on computer cards. The computer was programmed to compute SES and WCP by adding scores on the relevant items.

Analysis: The computer was also programmed to "breakdown" the mean scores on both SES and WCP according to Parents' Residence, location of schools, boarding versus



Day students, parents' Occupational groups, and educational levels. The program has a provision for testing the significance of the means.

Results and Discussions: Tables 1a and 1b show the results of the analysis. Both the SES and WCP discriminated significantly at  $P < .001$  level between the various groups. The only exception was in the case of Boarders versus Day students, both the SES and WCP failed to discriminate between the groups.

The fact that the SES index did not discriminate between the boarding and non-boarding students could be due to the fee-paying educational system existing in Nigeria at the time data for the present study was collected in 1976. The implication of the fee-paying educational system is that only parents who could afford the cost are able to send their children to schools, and such parents would, normally, belong to the high socioeconomic status. Not all the Day students stay out at the boarding houses because of financial reasons. Some parents, for example, might feel that they would have more opportunity to keep strict watch over the study habits of their children if they live at home rather than in the boarding house.

Similarly, the failure of the Western Culture Participation Index to discriminate between the boarding and

non-boarding students could mean that scores on this factor depend on conditions which are equally applicable to both boarding and non-boarding students. These conditions would include the general availability of the Western cultural objects and activities in a given area, the degree of each student's interest in exploring his surroundings, as well as the extent of each student's freedom to travel outside his immediate area during school vacation.

Judging from the level of significance at which the SES and WCP indices discriminated among the other specified factorial groups, it could be said that the inventory has a content validity in terms of fulfilling its function of categorizing a specified population according to the levels of the factors under investigation, namely socioeconomic status, and Western Culture Participation.

TABLE 1a  
A BREAKDOWN OF SES SCORES BY SUB-GROUPS SHOWING  
SIGNIFICANCE OF MEAN DIFFERENCES

	N	Mean	S.D.	F
Entire Population	246	18.1	7.1	
Residence				79.1***
Urban	197	20.3	6.2	
Rural	52	10.7	4.7	
School Location				67.8***
Urban	127	23.1	4.5	
Rural	119	16.5	7.2	
Students' Status				N.S.
Boarding	152	18.3	7.1	
Day Students	98	18.3	7.1	
Fathers' Occupation				151.0***
Group I	56	9.2	3.9	
Group II	23	13.0	3.8	
Group III	166	26.9	4.7	
Mothers' Occupation				135.8***
Group I	100	11.2	4.3	
Group II	33	19.6	3.1	
Group III	78	24.9	2.9	
Fathers' Education				86.9***
No Schooling	38	8.5	3.2	
Primary 1-6	39	12.0	4.1	
Secondary 1-4	15	15.3	4.9	
School Cert.	36	21.2	3.9	
HSC/GCE (AL)*4	27	23.8	4.5	
College degree	60	27.9	2.9	
Post Graduate	31	29.5	2.6	
Mothers' Education				78.6***
No Schooling	77	10.5	4.1	
Primary 1-6	42	16.0	4.7	
Secondary 1-4	37	20.8	3.6	
School Cert.	28	21.9	2.7	
HSC/GCE (AL)	23	24.9	2.7	
College Degree	36	26.1	1.9	
Post Graduate	3	28.0	0.0	

Note Maximum score = 38

\*\*\*p < .001

TABLE 1b

A BREAKDOWN OF WCP SCORES BY SUB-GROUPS SHOWING  
SIGNIFICANCE OF MEAN DIFFERENCES

	N	Mean	S.D.	F
Entire Population	245	137.2	40.7	
Residence				94.5***
Urban	197	145.7	35.0	
Rural	52	92.9	27.3	
School Location				93.8***
Urban	127	153.7	20.4	
Rural	119	103.6	37.7	
Students' Status				N.S.
Boarding	152	140.1	40.6	
Day Students	98	132.1	40.0	
Fathers' Occupation				69.2***
Group I	56	96.6	30.6	
Group II	23	108.0	30.2	
Group III	166	149.9	31.9	
Mothers' Occupation				42.5***
Group I	100	116.4	34.0	
Group II	33	143.4	25.7	
Group III	78	158.1	17.7	
Fathers' Education				26.8***
No Schooling	38	80.5	23.7	
Primary 1-6	39	107.2	24.9	
Secondary 1-4	36	123.1	28.0	
School Cert.	15	132.1	20.8	
HSC/GCE (AL)	27	144.1	31.6	
College degree	60	153.1	25.8	
Post Graduate	31	158.9	13.2	
Mothers' Education				28.2***
No Schooling	77	92.8	27.4	
Primary 1-6	42	125.6	27.1	
Secondary 1-4	37	140.2	19.8	
School Cert.	28	148.9	20.5	
HSC/GCE (AL)	23	153.7	20.5	
College degree	36	162.3	25.6	
Post graduate	3	163.1	14.4	

Note Maximum score = 188

\*\*\*p < .001

## CHAPTER IV

### PILOT STUDY

#### Why A Pilot Study Was Necessary

Schwarz and Krug (1972) observed that African subjects have great difficulty in coping with the format and administrative conditions of the 'standard' (European and American) aptitude tests. They suggested that in the event of administering such tests to African students, the test formats should be simplified and the tests should be printed each on a separate non-reusable paper.

Both the DAT battery and Raven's Progressive Matrices are printed in reusable booklets and their answer sheets are not part of the test booklets. It became necessary, therefore to investigate how Nigerian students would cope with the formats and administrative conditions of these tests, and thereby determine what modifications could be made if necessary.

Objective testing involving the multiple answer choice was introduced on a wide scale in Nigeria, as well as in other English-speaking West African countries in

1966 (Akeju 1972). That was after Schwarz and his AIR colleagues had conducted their research study which preceded the development of the I-D tests described in Chapter II. However, this form of test is used mostly in West African School Certificate examinations conducted by WAEC. The schools still use more of the essay-type examinations for internal assessments.

Another objective of the pilot study was to examine the relationship of the socioeconomic status and Western culture participation measures (described in Chapter III) to performance in each of the selected ability tests.

#### Sample For The Pilot Study

The sample consisted of 201 out of the 250 students used for the validation of SES/WCP inventory. The sampling procedure has been described in Chapter III.

#### Instruments

The materials used included the SES/WCP questionnaire, the five selected DAT battery tests, as well as the Raven's Progressive Matrices.

## Procedure

The selected students in each school were arranged in a large classroom to give the testing the air of a normal examination. It was assumed that this would enhance the motivation of the students. One of the class teachers generally addressed the students before the testing started, urging them to do their best in the tests. The investigator usually put the students in a relaxing mood before starting the tests without necessarily lowering their enthusiasm.

The questionnaire was administered first and this took about 20 minutes. It was followed by three of the DAT tests, Verbal Reasoning, Numerical Ability, and Abstract Reasoning. There was a demonstration exercise before starting off each test. During this period efforts were made to see that every student knew what to do, and where and how to record his answers. Once a test was started, individual questions were answered by referring the student to the printed instructions. Each of the DAT tests lasted for 30 minutes, after the first three tests, the students were sent out on a 25-minute break. When they returned, the Mechanical Reasoning and Space Relations tests were administered. The Raven's Progressive Matrices was the last to be administered each time. The students were allowed to work according to their own rate following

the instructions in the test manual. The students submitted their work when finished and left the examination hall.

#### Observations During the Testing Sessions

It was noticed that about three quarters of the students finished their responses in the DAT tests before the time limit. Also, about 80 percent of the students completed the Matrices between 15 - 20 minutes. The rest took about 25 - 30 minutes. The slow students were more in the rural located schools than in the urban schools.

It was observed during the test supervisions that, in spite of explanations, some students (in the rural areas) were confused about answer space provided for a particular test. This was partly due to the fact that the answer sheets for the DAT battery of eight tests are compiled into one pad. To avoid more of such confusion experienced by some of the students, the answer sheets were rearranged. Those for the tests which were not being used for the study were removed and the rest arranged in the order in which the tests were to be administered.

#### Analysis of Data

There was a descriptive analysis of the test scores according to location of schools, sex, and class. The means of these categorical groups were tested for



significance. There was also a Pearson correlation analysis aimed at investigating the type and level of association of the SES and WCP measures with each of the aptitude tests including the RPM.

### Results and Discussion

Table 2a describes the performance of the students in terms of means and standard deviations. The results show that in urban located schools, boys and girls in both classes three and four consistently scored higher in all the tests than their counterparts in rural located schools. Within the urban area, class difference was significant in all the tests for both sexes. This means that boys and girls in class IV have higher mean scores in all the tests than their counterparts in class III. Within the urban locations also, boys significantly performed better than girls in Verbal Reasoning, Mechanical Reasoning, and Space Relations tests, but there were no significant differences between the performance of boys and girls in Numerical Ability, and Abstract Reasoning tests, as well as in the Raven's Progressive Matrices.

Within the rural located schools, on the other hand, there is significant class difference for boys in all the tests except in the Abstract Reasoning test, and the Raven's Matrices. This means that boys in classes III

and IV performed equally well in these two tests. For the girls within this location, class difference is not significant in Mechanical Reasoning and Space Relations tests.

The cross-correlation analysis show that SES correlates .60 with WCP, this shows that the two indices are not measuring exactly the same thing. The results of this analysis also show that SES correlates higher than WCP with Abstract Reasoning, Numerical Ability, and Raven's Matrices. WCP, on the other hand, correlates higher than SES with Mechanical Reasoning, Space Relations, and Verbal Reasoning tests. These results will be further discussed along with the result of the major study to be described in the next Chapter. Test-retest reliability for the SES and WCP measures (after four weeks) was .81 for SES and .80 for WCP. These coefficients appear to be high enough for instruments of this nature.

TABLE 2a

(Analysis of Data for the Pilot Study)

A BREAKDOWN OF STUDENTS' SCORES ON EACH OF THE APTITUDE TESTS  
SHOWING MEAN SCORES AND STANDARD DEVIATIONS ACCORDING TO CLASS,  
SEX, AND SCHOOL LOCATION

	Class	URBAN SCHOOLS				RURAL SCHOOLS			
		BOYS		GIRLS		BOYS		GIRLS	
		3	4	3	4	3	4	3	4
	N	21	31	33	27	23	24	30	22
Verbal Reasoning 50 items	$\bar{x}$	18.2	25.9**	18.6	20.0**	14.2	16.5*	15.0	16.0 <sup>NS</sup>
	sd	7.0	7.0	6.0	7.0	6.1	6.1	5.3	5.0
Numerical Ability 40 items	$\bar{x}$	22.6	28.9**	21.7	27.8**	21.0	22.6*	18.0	22.4**
	sd	9.2	5.6	6.2	6.2	8.5	8.2	6.1	4.6
Abstract Reasoning 60 items	$\bar{x}$	33.6	36.9**	28.2	35.4**	28.7	29.0*	26.5	27.0 <sup>NS</sup>
	sd	7.1	6.8	10.0	6.3	9.2	9.1	11.9	8.7
Mechanical Reasoning 70 items	$\bar{x}$	32.7	38.3**	29.4	35.2**	29.9	33.8**	26.1	26.6 <sup>NS</sup>
	sd	9.1	7.1	8.7	7.3	9.0	8.3	4.9	3.8
Space Relations 60 items	$\bar{x}$	22.3	30.3**	19.3	22.0**	19.4	22.0**	17.6	18.1 <sup>NS</sup>
	sd	9.4	10.4	6.7	7.3	8.9	7.4	4.9	5.1
Raven's Matrices 60 items	$\bar{x}$	44.0	49.2**	44.0	47.5**	44.2	43.9 <sup>NS</sup>	38.8	40.0 <sup>NS</sup>
	sd	11.0	8.5	12.0	7.0	9.4	10.6	12.2	11.3

Note: The significance of the mean score differences, in the above specified subgroups, on each test was tested by One-Way Analysis of Variance in the Breakdown Program of the SPSS computer program. Class differences by Sex and School Location are significant or not significant as indicated above.

\*P &lt; .01

\*\*P &lt; .001

NS = not significant

TABLE 2b  
INTERCORRELATION MATRIX OF SCORES ON  
SES, WCP, AND THE SELECTED APTITUDE TESTS

	WCP	SES	VR	NA	AR	MR	SR	RPM
SES	.6003**	-	-	-	-	-	-	-
VR	.3597**	.3144**	-	-	-	-	-	-
NA	.1946*	.1955*	.5244**	-	-	-	-	-
AR	.2210**	.2068**	.5270**	.5399**	-	-	-	-
MR	.4464**	.2474**	.4570**	.3056**	.4238**	-	-	-
SR	.3547**	.1912*	.4421**	.3838**	.5244**	.5328**	-	-
RPM	.1205*	.2360**	.4205**	.3631**	.5232**	.4000**	.4299**	-

Note \* $p < .01$

\*\* $p < .001$

WCP - Western Culture Participation

SES - Socioeconomic Status

VR - Verbal Reasoning Test

NA - Numerical Ability Test

AR - Abstract Reasoning Test

MR - Mechanical Reasoning Test

SR - Space Relations Test

RPM - Raven's Progressive Matrices

CHAPTER V

MAJOR STUDY

METHOD

Sampling Procedure

The target population for the study was a cross section of specified sub-cultural groups of Nigerian Secondary school students. To get a representative sample of that population, a stratified random sampling technique was used. It was also planned to select a sample which would reflect the various educational practices that went on in the former Nigerian Regions before they were subdivided into States.

Appendix A presents a map of Nigeria indicating the four political Regions under which Nigeria operated after Independence in 1960. The Regions were known as Eastern, Western, Mid-western, and Northern Regions. Each of them was responsible for its Primary and Secondary education. All the Regions followed the British system of education, but there were variations in school policies and practices. For example, some Regions operated free primary education long before it was tried in other regions. Similarly,

some regions believed and emphasized co-education at the secondary level and others operated more than 90 percent of their secondary schools as single sexed schools. In 1969 the Regions were subdivided into 12 States (see Appendix B), and in 1976 they were further sub-divided into 19 states. The Mid-Western Region was not subdivided but was renamed Bendel State.

Within each of the four Regions, (except the Mid-West), a state was randomly selected. Thus Imo, Oyo, Bendel, and Kaduna states were selected. In April, 1976, a letter was written to the Ministry of Education in each of the selected States, explaining the purpose of the study and soliciting their cooperation (reference Appendix D). Between May 17 and May 28, 1976, the author met with the officers handling the matter in each of the Ministries of education. The Inspectorate Division of each Ministry has a classification of the schools in State under various categories such as, Urban, Rural, Boys, Girls, Commercial, Technical, Grammar, Poor, Good, etc. The "poor" and "good" schools were classified according to their performance in the West African School Certificate examinations. The "good" schools include those who have at least 33 percent passes yearly in the WASC. To control the influence of quality of schools in the study, only the "good" schools were included in the sample. Also, to control the influence

of "previous learning" on some of the tests, the selection was limited to secondary Grammar schools.

From the classified lists of schools in each State six schools were randomly selected under the following basis:

Urban Area (Townships)

1 Boys School  
1 Girls School  
1 Mixed School

Rural Area (Villages)

1 Boys School  
1 Girls School  
1 Mixed School

Thus, 24 schools were selected from the four States, however, only 21 schools were used in the data processing (see Appendix C). Each State Ministry of Education was requested to contact the principals of the selected schools about the study and subsequent arrangements. Appendices E to H are samples of replies from the Ministries of education showing the extent of their cooperation in the project. Each principal of the selected school was sent a letter from his State Ministry of education informing him of the purpose of the study, the date on which a sample of his students would be tested and asking for his cooperation.

The students were selected in the morning of the day the test was scheduled in each school. The investigator generally arrived at the school by 8:00 a.m. while the school was at Morning "Assembly." With the aid of a teacher or sometimes the principal, the Registers of the

relevant classes were collected. Thirty students were selected from each class using a systematic random sampling technique. Every 5th student in the Register was selected. If the total number thus selected from one class was more than the required number, a lottery-method random sampling was used to select the right number. The students thus selected were informed and called out of their classes after the Assembly. In the Mixed schools, the boys and girls were sampled separately and efforts were made to balance the numbers.

### Subjects

The subjects consisted of 1,230 Nigerian students selected in the manner described above. Table 3a gives a distribution of the population within the sample. Only the valid observations in each category were used, that is, missing observations were not included in the data processing for specific factors. There are 595 (48.4%) of Form IV students and 633 (51.5%) of Form V students; 690 male (56.1%) and 536 Female (43.6%) students. 645 (53.2%) of them are in Urban, and 573 (46.6%) are in Rural located schools. 1,018 (82.8%) students are Boarders and only 207 (16.8%) are Day students. 260 (21.1%) of the students have fathers who have no schooling at all, 351 (28.5%) have fathers who have between Primary I and Primary 6 education, 128 (10.4%) of the students' fathers had secondary education



TABLE 3a  
 FREQUENCY DISTRIBUTION OF THE SAMPLE POPULATION  
 SHOWING THE ABSOLUTE AND RELATIVE SIZES OF  
 THE VARIOUS SUBGROUPS

	Absolute Frequency	Relative Frequency
	N	Percent
Total Population	1,230	100.0
Class		
Four	595	48.4
Five	633	51.5
Sex		
Male	690	56.1
Female	536	43.6
School Location		
Urban	654	53.2
Rural	573	46.6
Residence		
Village	437	35.5
City	790	64.2
Student Status		
Boarding	1,018	82.8
Day Student	207	16.8
Fathers' Education		
No Schooling	260	21.1
Primary 1-6	351	28.5
Secondary 1-4	128	10.4
Schooling Cert.	179	14.6
HSC/GCE (AL)	68	5.5
College degree	159	12.9
Post graduate	82	6.7

TABLE 3a (Con't)

	Absolute Frequency	Relative Frequency
	N	Percent
Mothers' Education		
No Schooling	559	45.4
Primary 1-6	369	30.0
Secondary 1-4	89	7.2
School Cert.	112	9.1
HSC/GCE (AL)	31	2.5
College Degree	55	4.5
Post Graduate	11	.9
Fathers' Occupation*		
Group I	452	36.7
Group II	329	26.7
Group III	441	35.9
Mothers' Occupation		
Group I	930	75.6
Group II	174	14.1
Group III	121	9.8

Note \*Examples under each group are shown in Appendix H

ranging from Secondary I to IV. 179 (14.6%) of the fathers have West African School Certificates (WASC) or the London General Certificate of Education (GCE) Ordinary Level. 68 (5.5%) of them possess the Higher School Certificate (HSC) or the GCE Advanced Level. 159 (12.9%) have college degrees while 82 (6.7%) of the fathers have post graduate qualifications.

On the Mothers' Level of Education, 559 (45.4%) of the mothers had no schooling at all, 369 (30.0%) have between Primary I and Primary VI; 89 (7.2%) have between Secondary I and IV; 112 (9.1%) have WASC or GCE Ordinary Level. 31 (2.5%) of the mothers have either HSC or GCE Advanced Level; 55 (4.5%) have college degrees while 11 (0.9%) hold post graduate qualifications.

It is observed that 437 (35.5%) of the parents live in Villages and 790 (64.2%) of them live in the cities. The Parents Occupational Levels show that 452 (36.7%) of the fathers and 930 (75.6%) of the mothers are engaged in occupations classified as Group I (see Appendix H). 329 (26.7%) of the fathers and 174 (14.1%) of the mothers are engaged in Group II type of occupations, while 441 (35.9%) of the fathers and 121 (9.8%) of the mothers are in Group III types of occupations. Group I contains unskilled types of jobs, and Group II contains semi-skilled jobs, while Group III contains skilled and professional jobs as well

as 'big' private Business enterprises. The large proportion of mothers in Group I is explained by the fact that some mothers in certain parts of the Federation do not engage in jobs outside their homes as a result of religious practices. That also accounts for the high proportion of mothers with no schooling at all.

### Materials

The materials used for the study include five Aptitude tests, one general Ability test, and an Inventory which measures Socioeconomic status and Western Culture participation. The Aptitude tests are five of the Differential Aptitude Tests (DAT) battery, while the general ability test is the Raven's Progressive Matrices (RPM).

### The Differential Aptitude Tests

The DAT were developed in 1947 by George Bennett, Harold Seashore, and Alexander Wesman, all of whom were at the Psychological Corporation, New York. In 1962 the tests were revised (Forms L & M) and restandardized. In 1972, they were revised again (Forms S & T) and five of the tests were updated. The DAT form an integrated battery of tests developed to measure academic as well as specific aptitudes. They were designed for educational and vocational guidance and counselling purposes, (DAT Manual, 1975). The various tests that make up the battery are standardized on the same populations, (grades 8 - 12 of American Schools).

This makes the DAT more suitable for research on secondary school aptitude testing, than any assembled battery of tests which might have been separately developed for different purposes, different age groups, and/or different populations. Because the tests measure 'level' of performance at the time of testing, emphasis is on 'power' rather than speed, except where a particular test such as the clerical skill test, measures speed and accuracy.

The tests are normed separately for boys and girls to show sex differences on individual tests. The reason behind this is based on Wesman's suggestion (Wesman 1949b) that separate sex norms be calculated for a curriculum in which competition comes "preponderantly" from a single sex. It was discovered from previous research studies on DAT that boys tend to score higher than girls in tests such as Mechanical Reasoning and Spatial Relations, while girls score higher than boys in tests such as Clerical Speed and Accuracy, Spelling and Language Usage. For counselling purposes the authors suggest that individuals be compared with the higher scoring groups' performance on individual tests. For example, a girl's mechanical aptitude should be judged from her performance compared to those of boys of her age group on the Mechanical Reasoning test. Similarly, the norming procedure of the DAT was carried out with the use of stratified random sampling technique on a large

variety of students from various school districts, public and parochial, as well as schools from various socioeconomic backgrounds. These facts render the battery appropriate for the present study which involves assessment of the effects of factors such as sex, social environment, and family background on the performance of students from schools in various geographical locations in Nigeria. It is realized however, that levels of SES and of Western acculturation will not be the same in America and Nigeria, the study therefore is intra-cultural rather than cross-cultural.

The five tests selected from the DAT battery are, the Verbal Reasoning (VR), Numerical Ability (NA), Abstract Reasoning (AR), Mechanical Reasoning (MR), and Space Relations (SR) tests.

#### The Verbal Reasoning Test

The Verbal Reasoning (VR) test consists of verbal-analogy items which require the students to recognize a sort of relationship in concepts framed in words. It tests the student's ability to think constructively rather than at simple fluency or vocabulary recognition, (DAT Manual, 1975). The authors explain that performance on this test could be regarded as an indication of the occupational level to which a student aspires, since, according to them, there is a positive relationship in many occupations

between the level of responsibility of a job and the complexity of verbally phrased ideas to be comprehended. This will, however, be true only on the assumption that the test samples concepts from a wide variety of jobs, and the authors explain that it does.

### The Numerical Ability Test

The Numerical Ability (NA) test is designed to assess understanding of numerical relationship and facility in handling numerical concepts. The items are more of the "arithmetic computation" type than of the "arithmetic reasoning." The difference is that the former does not contain verbally worded items. As a measure of the student's ability to reason with numbers, and to manipulate numerical relationships, the NA is used educationally, for prediction in fields such as mathematics, physics, chemistry, engineering, and any other curricula in which quantitative aptitude is essential. Many occupations require numerical ability; these include bookkeeping, toolmaking, carpentry, and similar crafts. The fact that the NA and VR are so fundamental to many fields, leads to the use of the two tests combined by some educationists as a measure of "General learning ability."

### The Abstract Reasoning Test

The Abstract Reasoning (AR) test is a non-verbal measure of the student's reasoning ability. The items consist of series of diagrams which are presented in form of problems. The student has to discover the operating principle governing the changing diagrams and demonstrate his understanding of it by designating the diagram which should logically follow. The test evaluates ability to perceive relationship in abstract figures or patterns.

### The Mechanical Reasoning Test

The Mechanical Reasoning test (MR) is described as a specially constructed version of the Mechanical Comprehension Tests originally developed by the authors. Each item consists of a pictorially presented mechanical situation together with a simply worded question. The items are based on "simple, frequently encountered mechanism that do not resemble textbook illustrations or require special knowledge," (DAT Manual 1974, pp. 8-9). The test predicts ability to learn principles of operations and to repair complex devices. It also serves as a predictor in physical science fields and in technical or manual training courses in occupations such as carpentry, mechanics, assembling and maintenance jobs. The authors explain that performance in this test is affected by previous experience but not to a degree that introduces serious difficulties in interpretation.



### The Space Relations Test

The Space Relations (SR) test is a measure of ability to deal with concrete materials through visualizations. It also evaluates one's ability to manipulate things mentally and to create a structure in one's mind. The test is designed to assess students' ability to manipulate objects in three-dimensional space. The items present tasks that call for judgments of how objects would look if constructed and rotated. The SR test serves as a predictor in fields such as drafting, dress designing, architecture, etc.

### The Raven's Progressive Matrices

In addition to the above five DAT tests, the Raven's Progressive Matrices (RPM) is used for the study. The RPM is a "test of observation and clear thinking" (Raven, 1960). It was developed in 1938 by J. C. Raven and in 1956 some of the items were rearranged. There are three sets of Matrices developed by Raven, these are the Standard Progressive Matrices, the Colored Matrices, and the Advanced Progressive Matrices. For the present study the Standard Progressive Matrices Sets A - E was used. Raven (1960) describes this as a "test of a person's capacity at the time of the test to apprehend meaningless figures presented for his observation, see the relations between them, conceive the nature of the figure completing each system of relations presented, and by so doing, develop a systematic

method of reasoning." The items of the test are arranged in such a way that they provide an opportunity to transfer the experience of solving the easy items to the solution of the more difficult items. In this regard the test could be regarded as a test of ability to learn.

The Socioeconomic Status and Western Culture Participation Inventory has already been described in Chapter III.

### Procedure

Preparations: Over 90 percent of the principals of the selected schools cooperated with the researcher, having been previously informed about the testing project as well as the date the testing was to be carried out in their different schools. (Appendices D - G.)

On the testing date in each of the schools, after the selection of the students in the way already described, the selected students from both classes were put together in a room large enough to hold all of them in a normal examination arrangement. The principal or his delegated aid generally addressed the participating students; introducing the researcher and the purpose of the research, and frequently ended by urging the students to do their best on their tests. These preparations contributed towards the motivation of the students for the test.

Instrumentation: The investigator made efforts to lessen any high anxiety which might have been called up by the teacher's address or threat in some cases, by establishing a good rapport with the students without necessarily dampening their motivation. The SES/WCP Inventory was administered first and during this period the students were encouraged to ask questions while the proctors went around to give individual help to those who needed it. It took about 20 minutes to administer the Inventory. The researcher read the items aloud while the students followed silently and made their responses as each item was read and explained. This was then followed by three of the DAT tests, namely: The Verbal Reasoning (VR), Numerical Ability (NA), and the Abstract Reasoning. Each of them lasted for 30 minutes. There was a demonstration period of about five minutes before each test during which the researcher made sure that each student understood what he was required to do in a specific test as well as where and how to record his answers.

At the end of the administration of the AR test, the students were sent out for 25 minutes break. When they came back, the remaining two DAT, i.e., the Mechanical Reasoning and the Space Relations tests were administered. The MR took 30 minutes while the SR took 25 minutes to administer. The suggested times for the tests in the DAT Manual were adhered to after demonstration exercises.

## Statistical Analysis

Introduction: It has already been pointed out that the present study is an exploratory one, which implies that the analyses are done without a priori hypotheses. However, the inquiry is guided by the aim of the study. The principal aim is to find suitable basis for local norms in the event of an introduction of aptitude testing program into Nigerian secondary schools. It has been said that the present Nigerian cultural environment is less homogeneous than that of an advanced technologically industrialized society. It is, therefore, possible that the different operating social and environmental factors in the present Nigerian culture may create "subgroups" with regards to performance on aptitude tests used to assess modern technological skills. If this is true then local norms in Nigeria for aptitude tests developed in technologically advanced countries should make allowance for "subgroup" interpretations. Analysis of the data for the present study is aimed at discovering the existence of such subgroups, if any.

Assumptions: In the analysis it is assumed that the specified social and environmental factors under investigation could create identifiable subgroups as a result of their separate or combined influence on various students. Each factor is thus regarded as constituting a "factorial" group

with distinguishable levels. Each subgroup is thus regarded as a "treatment" group within a given factorial group. The treatment in this case is the common experience of the subgroup within a factorial level. The effect of each factor is determined by testing for significance, the "between-group" mean scores differences of the various factorial levels on each of the aptitude tests. Since there are about seven independent and six dependent variables involved, the analysis thus requires a powerful multivariate analytical technique which would assess the effects of the given independent variables (the specified factors) on the dependent variables (performance on the aptitude tests).

Statistical Technique: As a result of the above described conditions, the statistical technique selected to analyze the data is Analysis of Covariance, (ANCOVA). The ANCOVA technique is a link between Analysis of Variance (ANOVA) and Regression Analysis (REGA). ANOVA is usually used when the independent variables are predominantly categorical or qualitative in nature, while REGA is used when all the independent variables are measured on at least interval scale. ANCOVA, on the other hand, is used when the independent variables include both qualitative and quantitative ones. (Nie et. al. 1975).

The independent variables in this study are sex, socioeconomic status (SES), Western Culture Participation (WCP), School Location (SCLOCAT), Parents' Residence (RESID), Student's Status, i.e., boarding versus non-boarding, and Student's Class (CLS). Performance on the Raven's Progressive Matrices (RPM) which is a "general intelligence" test is used both as independent and dependent variables in the study. Sex is a categorical factor and is measured on nominal scale. SCLOCAT and RESID each has "village" and "City" categories, thus they appear qualitative and dichotomized. It is, however, assumed in the analysis that these factors have "inherent rank-order" in the context of the study. This means that a city location of school or residence is considered higher than a village environment with regards to technological aptitude development. Values are therefore assigned to the factorial levels according to the rules of "interval-scale" level of measurement. SES and WCP are also qualitative attributes but the indices used in this study are computed from variables measured at an interval scale level as described in Chapter III. Those factors are therefore used along with RPM scores as covariates in the analysis.

Opinions are divided on the issue of levels of measurement and appropriate statistical techniques for

analysis. Some researchers advise that where possible it is more preferable to use a more powerful statistical technique which is more sensitive and has known sampling error than less powerful (rank-order) techniques often used in social or behavioral science research studies. Labovitz (1970), Abelson and Tukey (1970), among others, have tried to demonstrate that ordinal data could be treated as if they conform to an interval scale level. This approach will render such data suitable for multivariate type of analysis. Labovitz (1970) argues that some small error may accompany the treatment of ordinal level as interval level, but that such error could be offset by use of more powerful and robust statistical techniques.

The data were processed with a computer program taken from the system of Statistical Packages for Social Sciences (SPSS). The Analysis of Variance (ANOVA) program within the system has a sub-program for Analysis of Covariance. This sub-program is used when the independent variables include both categorical and continuous variables as described above. It also works on the assumption that the covariates have linear relationship with the dependent variables. Table 2b shows a Pearson correlational matrix between the covariates and the dependent variables used in the analysis. The covariates are SES, WCP, and RPM scores. It could be observed that the covariates correlate

positively and significantly with all the dependent variables at  $P \leq .001$  and  $P \leq .01$ .

Post-hoc Analysis: It was necessary to do some post-hoc analysis in view of the fact that "significant effect" of a given factor in Analysis of Variance or Covariance, only indicates that there are substantial differences between groups within the different levels of that factor, it does not show the pattern of this group variance. In this study the pattern of group differences is shown by Multiple Classification Analysis (MCA): a sub-program in the ANCOVA Program. The MCA gives the mean-score deviations of students in each categorical level from the grand mean. It also shows the individual contribution of each categorical factor, before and after adjustments of the effects of the other factors including the covariates. The statistics which assess these individual contributions are "Eta" and "Beta."

"Eta" is a measure of association used when the independent variable is measured on nominal level and the dependent variable is on interval or ratio level. It indicates the similarity or otherwise of group means of the various levels within a categorical factor. Its square gives an estimate of the proportion of the variance accounted for by the factor under consideration. (Nie et. al. 1975).



"Beta" could be interpreted as a standardized "partial regression coefficients" (Nie et. al. 1975) in the sense that it is a measure of an accompanying changes in Y' (the dependent variable) given a unit change in X (the independent variable) while controlling for the effects of the other factors. It is also a "partial correlation ratio." Thus the higher the correlation of a factor with the others factors the lower its Beta value, and vice versa.

The pattern of the effects of the covariates such as socioeconomic status (SES) and Western Culture Participation (WCP), is examined by matching students according to levels of each factor. Scores on each of the tests were "broken down" according to each covariate group. Tests, performance on which have stronger association with SES in relation to WCP, are broken down according to SES levels, while those which have stronger association with WCP are broken down according to WCP levels.

The "breakdown" exercise is also used for detailed analysis of performance of students within Urban or Rural environment when matched according to other factors. This is another measure of controlling confounding effects of other factors in order to enhance the actual effect of a specific factor under investigation.

Control of Confounding Factors: Three covariates are used in the analysis to control individual differences in order to increase the sensitivity of the tests to the other factors. At the same time the covariates in themselves are factors of interest in the study. Their individual effects on performance on each test are also examined. The covariates are socioeconomic status (SES), Western Culture Participation (WCP), and general ability (GA) measured in terms of students' scores on the Raven's Progressive Matrices.

"General ability" is defined in this study as the ability to see relations, which is the way it is defined in the technological culture. According to Jensen's (1969) explanations, Spearman, through the use of factor analysis, observed that a common factor underlies all ability tests which measure higher mental and complex activities irrespective of what specific abilities each test measures. Spearman described this common factor as the ability to "educe" relations and designated it as "general intelligence," or "g."

It is expected that the development of the ability to see relations in Western terms among Nigerian students would depend partly on individual level of Western Culture Participation, but largely on individual natural potential "to learn" in the Western form of education in general. The

choice of scores on Raven's Progressive Matrices (RPM) to measure and control this ability depends on a number of considerations. According to Raven (1975) the RPM has been found to have a Spearman's "g" (general intelligence) saturation of about 82 percent. During the pilot study RPM was administered along with the DAT battery on a sample of Nigerian students selected randomly. A cross-correlation matrix reported in Table 2a show that RPM has a considerably high and positive correlation coefficients with each of the DAT tests. Besides, students were to do the RPM test according to individual rate of working; there was no time limit. The matrices start with very simple ones and get progressively difficult. Also, the sets are arranged in such a way that ideas used in solving the simple ones could be transferred to the solution of the more difficult ones (Raven, 1975). In addition to all these, the items of the RPM test consist of "meaningless" patterns and diagrams.

It is realized, however, that the RPM, being an ability test developed in a technological culture, performance on the test might be subject to some other environmental factors, but this problem is taken care of in effect by the fact that the students are selected according to these environmental factors, such as School

location and Residence. Thus, the effect of each factor is substantively controlled. A cross-correlation of both the dependent and independent variables (Table 3b) show that some of the independent variables significantly correlate among themselves. This indicates that there could be some confounding effects of some factors on the effect of the others. This problem is statistically controlled by the model of ANCOVA used in processing the data. While assessing the effect of an individual factor, the model adjusts for the effect of all other factors including the covariates. Similarly, in assessing the significance of each interactions effect, the effects of the main factors and the covariates, as well as the effects of other interactions are adjusted for.

TABLE 3b

INTERCORRELATION MATRIX OF THE DEPENDENT AND INDEPENDENT  
VARIABLES SHOWING THE DEGREE OF ASSOCIATION OF THE  
VARIABLES WITH ONE ANOTHER

	CLS	LOCAT	RESID	SEX	SES	WCP	VR	NA	AR	MR	SR	RPM
CLS	-	0249	0196	0208	0057	1006**	1860**	2543**	1322*	1533*	1136*	1237*
LOCAT	-	-	2351**	0775*	2976*	3136*	2490*	1990*	1927*	2891*	1900*	2871**
RESID	-	-	-	0380	4701*	3125**	2233*	1750*	1700*	1330*	1518*	1741**
SEX	-	-	-	-	0759*	0255	1368*	2020*	1470*	3419*	1488*	1357**
SES	-	-	-	-	-	5917**	3547*	2443*	2598*	1874*	2328*	2387**
WCP	-	-	-	-	-	-	3482*	2272*	2327*	4511*	4011*	2272**
VR	-	-	-	-	-	-	-	5415**	4558*	4118*	4089*	4249**
NA	-	-	-	-	-	-	-	-	5134*	4028*	4307*	4561**
AR	-	-	-	-	-	-	-	-	-	4304*	4629*	5232**
MR	-	-	-	-	-	-	-	-	-	-	4624*	3674**
SR	-	-	-	-	-	-	-	-	-	-	-	4450**
RPM	-	-	-	-	-	-	-	-	-	-	-	-

Note: \* $p \leq .01$   
 \*\* $p \leq .001$

## CHAPTER VI

### RESULTS

#### General Descriptions

Tables 3c and 3d give an overview and general description of performance of students in various categories on each of the aptitude tests. They show the means, standard deviations, minimum and maximum scores of the various sub-groups on a given test.

It is observed that students in rural located schools, at all categorical levels, have lower mean scores than their counterparts in the urban located schools in all the tests. Also, an examination of the minimum and maximum scores in each test within the various groups exhibit large ranges of up to 40 points. Such extreme situations could be a result of indiscriminate admissions of students by some secondary school principals in Nigeria in order to attract financial aids from the governments, which are often given on account of "size of schools."

The detailed results of performance on each test following the observed effects of the specified factors under investigation, are given test by test. This is because the

TABLE 3c

DESCRIPTIVE STATISTICS OF CLASS IV STUDENTS' SCORES ON THE VARIOUS APTITUDE TESTS SHOWING MEANS, STANDARD DEVIATIONS, MINIMUM, AND MAXIMUM SCORES FOR BOYS' AND GIRLS' AS WELL AS MIXED SCHOOLS LOCATED IN URBAN AND RURAL AREAS

TESTS		TOTAL POP.	URBAN	URBAN	URBAN MIXED		RURAL	RURAL	RURAL MIXED	
			BOYS'	GIRLS'	BOYS	GIRLS	BOYS'	GIRLS'	BOYS	GIRLS
	N	597	110	107	42	40	112	86	42	38
VERBAL	$\bar{x}$	15.5	16.5	16.4	14.3	14.1	12.4	11.6	13.4	11.0
REASONING	sd	6.0	6.1	5.1	5.0	4.5	3.6	3.4	3.4	3.3
	Min	3.0	3.0	6.0	4.0	6.0	4.0	3.0	3.0	2.0
50 Items	Max	33.0	30.0	33.0	28.0	30.0	24.0	26.0	27.0	23.0
NUMERICAL	$\bar{x}$	18.1	21.4	18.3	18.9	17.0	18.0	17.6	18.6	14.1
REASONING	sd	8.3	8.6	8.0	8.1	7.3	5.6	7.3	7.4	8.1
	Min	2.0	2.0	4.0	5.0	4.0	4.0	2.0	4.0	2.0
40 Items	Max	34.0	34.0	34.0	33.0	31.0	30.0	30.0	33.0	28.0
ABSTRACT	$\bar{x}$	26.3	28.4	28.3	26.5	26.5	24.0	25.4	25.6	23.6
REASONING	sd	10.1	10.0	11.1	10.2	10.5	10.0	11.1	10.2	10.0
	Min	2.0	2.0	5.0	6.0	7.0	5.0	6.0	2.0	4.0
60 Items	Max	44.0	42.0	44.0	42.0	41.0	41.0	40.0	39.0	40.0
MECHANICAL	$\bar{x}$	29.2	35.8	29.4	33.9	30.4	30.9	27.3	30.1	28.1
REASONING	sd	8.5	8.3	7.4	8.0	8.6	8.1	7.8	8.1	7.7
	Min	6.0	16.0	13.0	14.0	12.0	4.0	6.0	5.0	4.0
70 Items	Max	49.0	49.0	44.0	46.0	40.0	41.0	39.0	41.0	40.0
SPACE	$\bar{x}$	17.1	20.5	18.4	19.4	17.1	15.1	13.5	16.2	14.3
RELATIONS	sd	6.3	7.1	6.7	6.0	5.4	3.8	4.0	6.1	3.4
	Min	4.0	5.0	8.0	6.0	4.0	3.0	2.0	4.0	2.0
60 Items	Max	46.0	46.0	32.0	44.0	30.0	24.0	20.0	31.0	30.0
RAVEN'S	$\bar{x}$	36.1	44.0	44.1	42.4	43.1	34.0	30.4	34.1	30.1
PROGRESSIVE	sd	11.0	11.1	12.0	11.3	10.6	10.1	9.9	10.1	10.1
MATRICES	Min	3.0	15.0	17.0	10.0	9.0	5.0	3.0	6.0	3.0
60 Items	Max	56.0	52.0	56.0	55.0	53.0	50.0	50.0	54.0	52.0

TABLE 3d

DESCRIPTIVE STATISTICS OF CLASS V STUDENTS' SCORES ON THE VARIOUS APTITUDE TESTS SHOWING MEANS, STANDARD DEVIATIONS, MINIMUM, AND MAXIMUM SCORES FOR BOYS' AND GIRLS' AS WELL AS MIXED SCHOOLS LOCATED IN URBAN AND RURAL AREAS

TESTS		TOTAL POP.	URBAN	URBAN	URBAN MIXED	URBAN MIXED	RURAL	RURAL	RURAL MIXED	RURAL MIXED
			BOYS'	GIRLS'	BOYS	GIRLS	BOYS'	GIRLS'	BOYS	GIRLS
	N	633	125	129	59	40	126	77	60	40
VERBAL	$\bar{x}$	17.2	19.2	17.4	16.1	15.4	13.1	11.8	14.1	12.5
REASONING	sd	6.5	7.5	8.6	5.1	4.6	3.7	3.8	3.9	3.5
	Min	4.0	6.0	8.3	6.0	6.0	4.0	6.0	5.0	4.0
50 Items	Max	40.0	39.0	40.0	31.0	30.0	26.0	25.0	25.0	22.0
NUMERICAL	$\bar{x}$	20.0	24.4	20.3	20.1	18.6	20.6	18.0	20.6	17.8
REASONING	sd	9.5	9.6	9.5	8.3	7.3	4.9	7.9	7.8	7.1
	Min	2.0	7.0	6.0	5.0	5.0	4.0	3.0	4.0	2.0
40 Items	Max	40.0	39.0	40.0	38.0	40.0	37.0	37.0	36.0	25.0
ABSTRACT	$\bar{x}$	28.4	31.2	30.8	28.4	27.1	27.3	26.3	27.0	20.9
REASONING	sd	10.2	10.0	10.6	10.0	9.8	9.0	10.4	9.6	10.4
	Min	3.0	6.0	6.0	5.0	4.0	4.0	3.0	4.0	3.0
60 Items	Max	48.0	45.0	48.0	44.0	47.0	43.0	44.0	44.0	38.0
MECHANICAL	$\bar{x}$	32.4	38.0	32.1	35.1	31.9	33.6	28.4	33.0	26.9
REASONING	sd	8.0	8.1	6.6	7.1	7.9	6.4	7.7	8.0	6.3
	Min	5.0	17.0	10.0	10.0	5.0	5.0	6.0	6.0	6.0
70 Items	Max	59.0	59.0	46.0	52.0	43.0	40.0	45.0	45.0	30.0
SPACE	$\bar{x}$	19.8	23.0	20.1	21.5	19.0	21.0	16.4	19.1	16.3
RELATIONS	sd	6.8	7.6	6.5	6.1	6.2	4.9	5.9	5.6	4.9
	Min	4.0	8.0	4.0	6.0	4.0	4.0	5.0	5.0	5.0
60 Items	Max	53.0	53.0	37.0	36.0	35.0	31.0	36.0	36.0	28.0
RAVEN'S	$\bar{x}$	38.5	44.3	44.1	39.4	36.4	36.3	30.5	35.1	29.1
PROGRESSIVE	sd	11.6	11.4	12.3	11.3	11.4	11.4	12.2	11.4	11.1
MATRICES	Min	6.0	18.0	17.0	6.0	6.0	6.0	8.0	7.0	6.0
60 Items	Max	58.0	56.0	56.0	56.0	58.0	58.0	51.0	58.0	50.0



Analysis of Covariance (ANCOVA) results show, in general, that the significance of the different independent variables, including the covariates, and their interactions, as sources of group variances, vary from test to test.

In the descriptions of results, the covariate RPM would be referred to as "General Ability." On the Tables \*\*\*= $P \leq .001$ ; \*\*= $P \leq .01$ ; \*= $P \leq .05$ . NS = Not Significant.

#### Data Analyses Results of the Verbal Reasoning Test Performance

Table 4a gives the results of the ANCOVA on the Verbal Reasoning (VR) test. It is noticed that all the three covariates, socioeconomic-status (SES), Western Culture Participation (WCP), and General Ability (GA), are each significant at F-probability level of  $P < .001$ . Thus it could be said that the probability is less than one in 1000 times that the effect of each of the covariates on performance on VR test is a chance occurrence. The Raw (score) Regression Coefficients for the covariates are 0.167 for SES, 0.146 for WCP, and 0.159 for GA. Regression Coefficient can be interpreted as a linear association of an independent variable with a dependent variable. It also means an expected change on Y' (i.e., the predicted raw score on the dependent variable), with a change of one unit on X (the independent variable) while the effects

of the other variables are held constant.

The effects of the categorical factors are shown in the Main Effects Block. The combined effects of the factors in this section is significant at  $P \leq .001$ . Similarly, Student's Class (CLS) and SEX are both significant at the same level of probability. School Location (SCLOCAT), and Parents' Residence (RESID) are significant at  $P \leq .01$ . In the Interactions Effects section, CLS and SEX show a 2-way interactions effect at  $P \leq .02$  level.

Table 4b gives a result of Multiple Classification Analysis (MCA) of the categorical factors. It gives the grand mean or the mean score of the entire population on the Verban Reasoning Test. It also shows the unadjusted and adjusted deviations of the mean scores of each of the categorical groups within each factor. The associated statistics are "Eta" and "Beta."

The MCA Table for the VR test shows the grand mean on this test as 14.48. There are 50 items on the test. It is observed that under SCLOCAT, before the adjustment of the other factors, the mean score of students attending schools located in the villages deviates from the grand mean by -1.46 points. This gives the group mean as 13.02 (14.48 - 1.46). Similarly, the mean score of students attending schools located in the cities is 15.77, while

the Eta value for School Location is 0.25. However, after adjusting for the other factors, the mean scores stood at 14.09 for the Rural located schools and 14.82 for the Urban located schools. The Beta value of 0.07 suggests a high correlation of School Location with the other factors. In the same way, the mean deviations of the Students' Class (CLS) decreased after adjustment for the other factors, but not as much as in School Location.

The Multiple  $R^2$  for all the factors in the Main Effects Block is 0.293. It could thus be said that the factors jointly account for about 29 percent of group variations in performance in the Verbal Reasoning test.

Table 4c is a guide to the interpretation of the significant interactions effects of Class and Sex on Performance in the VR test. It gives a breakdown of the mean scores of the Verbal Reasoning by Class and by Sex within the different School Locations. It appears from the table that in the Urban area, class effect is more significant for female than for male students. For example, the difference between the score of classes IV and V boys is about 2.2 points, while the difference between classes IV and V girls is about 3.2 points. In the Rural located schools, on the other hand, class effect is more significant for male than for female students. While the difference

between the mean score of classes IV and V boys is 2.2 points, that of the classes IV and V girls is 0.07 points. This could be interpreted to mean that in the Urban area girls improve their Verbal Analogy skill with increasing number of school years (CLS) more than boys, while in the Rural schools boys improve their skill with increasing number of school years than girls. Consequently, sex effect is more significant for lower class (Class IV) than higher class (V) in the Urban schools but more significant for the higher class in the Rural area than for the lower class. The difference between the mean-scores of male and female students in class IV in the Urban area is 1.8 points while the difference in class V is 0.07 points. In the Rural area the difference is 1.1 points in class IV and 2.6 points in class V. Thus sex-difference narrows with increasing number of school years in the Urban located schools while it widens with the same factor in the Rural schools.

Table 4d gives a detailed breakdown of the mean scores according to the various categories within three levels of SES. It could be seen that in the High SES level SEX differences disappear and in class V within this level girls in the Urban schools have a slightly higher mean score than boys in the same SES level.

TABLE 4a  
ANALYSIS OF COVARIANCE RESULTS SHOWING SOURCES OF GROUP VARIATIONS  
IN PERFORMANCE ON THE VERBAL REASONING TEST

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIG.
Covariates	9363.410	3	3121.137	145.447	***
SES	409.161	1	409.161	19.067	***
WCP	314.429	1	314.429	14.653	***
RPM	4020.353	1	4020.353	187.351	***
Main Effects	1439.563	5	287.912	13.417	***
CLS	654.402	1	654.402	30.496	***
SEX	483.066	1	483.066	22.511	***
SCLOCAT	137.246	1	137.426	6.396	***
STATUS	8.391	1	8.391	0.391	NS
RESID	156.457	1	156.457	7.291	**
2-Way Interactions	241.977	10	24.198	1.128	NS
CLS X SEX	118.863	1	118.863	5.539	**
CLS X SCLOCAT	30.490	1	30.490	1.421	NS
CLS X STATUS	0.886	1	0.886	0.041	NS
CLS X RESID	3.397	1	3.397	0.158	NS
SEX X SCLOCAT	10.412	1	10.412	0.085	NS
SEX X STATUS	25.272	1	25.272	1.178	NS
SEX X RESID	0.137	1	0.137	0.006	NS
SCLOCAT X STATUS	0.493	1	0.493	0.023	NS
SCLOCAT X RESID	39.792	1	39.792	1.851	NS
RESIDUAL	25793.668	1202	21.459		
TOTAL	36838.617	1220	30.196		

TABLE 4b

MULTIPLE CLASSIFICATION ANALYSIS FOR PERFORMANCE  
ON THE VERBAL REASONING TEST SHOWING SUBGROUP MEAN DEVIATIONS  
FROM THE GRAND MEAN

Grand Mean = 14.48			Number of Items = 50		
VARIABLE + CATEGORY	N	UNADJUSTED DEVIATION	ETA	ADJUSTED FOR INDEPENDENTS + COVARIATES DEV'N	BETA
SCHOOL LOCATION					
Village	573	-1.46		-0.39	
City	648	1.29	0.25	0.34	0.07
CLASS					
Form 4	591	-1.06		-0.80	
Form 5	630	1.00	0.19	0.75	0.14
SEX					
Male	687	0.66		0.58	
Female	534	-0.85	0.14	-0.75	0.12
RESIDENCE					
Village	437	-1.35		-0.61	
City	784	0.75	0.18	0.31	0.08
STATUS					
Day Students	206	-0.47		-0.16	
Boarders	1,015	0.09	0.04	0.03	0.01
Multiple $R^2$					0.293
Multiple R					0.542

TABLE 4c

INTERACTIONS TABLE FOR PERFORMANCE ON THE  
 VERBAL REASONING TEST SHOWING CLASS BY SEX INTERACTIONS  
 ACCORDING TO SCHOOL LOCATION

		URBAN SCHOOLS		RURAL SCHOOLS	
		Class IV	Class V	Class IV	Class V
M A L E	N	156	186	171	175
	X	15.6	17.5	12.6	14.8
F E M A L E	N	152	157	114	113
	X	13.6	16.8	11.5	12.2

TABLE 4d

SPECIFIED SUBGROUP MEAN SCORES ON THE VERBAL REASONING  
TEST SHOWING PATTERN OF SUBGROUP DIFFERENCES IN  
URBAN AND RURAL LOCATED SCHOOLS

	URBAN SCHOOLS			RURAL SCHOOLS		
	N	$\bar{X}$	SD	N	$\bar{X}$	SD
Entire Population	650	15.7	6.1	574	13.7	4.1
Low SES						
Class 4						
Male	63	13.6	3.9	120	12.4	3.9
Female	59	11.9	4.5	77	11.5	3.2
Class 5						
Male	87	15.6	5.5	120	14.5	4.5
Female	54	12.8	3.8	72	11.8	3.2
Medium SES						
Class 4						
Male	54	14.9	3.9	37	12.8	4.5
Female	57	13.1	4.5	32	11.1	3.7
Class 5						
Male	67	18.7	6.5	43	14.5	2.3
Female	55	14.6	4.2	34	12.9	3.5
High SES						
Class 4						
Male	39	18.7	6.5	14	14.5	2.3
Female	36	17.7	7.5	5	13.2	2.2
Class 5						
Male	31	21.0	4.4	13	18.6	4.6
Female	48	21.3	5.6	7	13.7	6.4



Data Analyses Results of the Numerical Ability Test Performance

Table 5a describes the results of the Analysis of Variance (ANCOVA) on the Numerical Ability (NA) test. It shows that the three covariates are significant sources of variation at  $P \leq .001$ . The Raw Regression Coefficients are 0.277 for General Ability (GA), 0.176 for SES, and 0.128 for WCP. In the Main Effects Block, Class and Sex are significant at  $P \leq .001$ ; the other factors are not significant. There are two significant interactions effects, those are Class by Sex and Class by School Location.

Table 5b is a Multiple Classification Analysis (MCA) table showing the pattern of the group differences. It could be seen from the table that the grand mean for the test is 18.89. There are 40 items in the test. The table shows that Class has the strongest effect in the NA test. The mean score for Class four deviates -2.12 points from the grand mean. That gives the group a mean of 16.77, while class five has a mean score of 20.87. This gives a difference of about 4.10 points. However, Class interacts with Sex and School Location. Both School Location and Residence have high Eta values but very low Beta values showing their high correlation with the other factors. Sex, like Class, is also a significant factor on performance on the NA test. After adjustments for the other factors, Class differences is still about 3.06 points with Beta value of

0.20, and Sex difference is about 2.78 points with Beta value of 0.17.

The effects of Students' Status show that before adjustment for the other factors, Boarders have a mean score of 19.14 while Day Students have a mean score of 17.66, but the Eta value is only 0.07. After adjustments, however, the means stood at 19.00 for the Boarders and 18.37 for Day students and the Beta value is only 0.03. This factor has the lowest Eta value in this as well as in the previous test. The Multiple  $R^2$  for the categorical factors is 0.298, that means that the factors jointly account for about 30 percent variation on performance on the Numerical Ability test.

Table 5c is a plot of the Class by Sex and Class by School Location Interactions effects. It gives a breakdown of the mean scores of the test by School Location, by Class and by Sex. It could be observed from the plot that in the Urban located schools Class is significant for both boys and girls, but it is more significant for boys than for girls. In the Rural located schools, on the other hand, Class effect is significant only for boys and not for girls. Thus in the Urban schools Class V boys have a mean score that is 6.7 points above that of the Class IV boys, while Class V girls' mean score is 3.3 points

above that of the Class IV girls. In the Rural located schools, while Class V boys' mean score is 4.8 points above that of Class IV boys, Class V girls have the same mean score as Class IV girls. This suggests that girls in the Urban located schools increase their Numerical skill with increasing number of school years while girls in the Rural located schools appear not to be improving along with that factor. On the other hand, boys in both Urban and Rural located schools improve their Numerical Ability with increasing number of school years but boys in Urban schools improve more than boys in Rural located schools.

Table 5d, which is a breakdown of the NA scores according to the above factorial groups within the same level of SES shows that Sex differences within class gets narrower in the Urban area with increasing Class and level of SES while it gets wider in the Rural located schools.

TABLE 5a

ANALYSIS OF COVARIANCE RESULTS SHOWING SOURCES OF GROUP VARIATIONS  
IN PERFORMANCE ON THE NUMERICAL ABILITY TEST

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIG.
Covariates	18030.445	3	6010.148	136.852	***
SES	235.623	1	235.623	5.365	***
WCP	221.665	1	221.665	5.047	***
RPM	12244.641	1	12244.641	287.812	***
Main Effects	5386.836	5	1077.367	24.532	***
CLS	3128.660	1	3128.660	71.240	***
SEX	2039.902	1	2039.902	46.449	***
SCLOCAT	138.410	1	138.410	3.152	NS
STATUS	63.664	1	63.664	1.450	NS
RESID	16.199	1	16.199	0.369	NS
2-Way Interactions	2256.508	10	225.651	5.138	***
CLS X SEX	1469.373	1	1469.373	33.458	***
CLS X SCLOCAT	709.206	1	709.206	16.149	***
CLS X STATUS	116.432	1	116.432	2.651	NS
CLS X RESID	0.643	1	0.643	0.015	NS
SEX X SCLOCAT	2.914	1	2.914	0.066	NS
SEX X STATUS	1.372	1	1.372	0.031	NS
SEX X RESID	29.573	1	29.573	0.673	NS
SCLOCAT STATUS	14.588	1	14.588	0.332	NS
SCLOCAT RESID	88.175	1	88.175	2.008	NS
STATUS RESID	0.375	1	0.375	0.009	NS
RESIDUAL	52788.398	1202	43.917		
TOTAL	78462.188	1220	64.313		

TABLE 5b  
 MULTIPLE CLASSIFICATION ANALYSIS FOR PERFORMANCE  
 ON THE NUMERICAL ABILITY TEST SHOWING SUBGROUP  
 MEAN DEVIATIONS FROM THE GRAND MEAN

GRAND MEAN = 18.89		NUMBER OF ITEMS = 40			
VARIABLE + CATEGORY	N	UNADJUSTED DEVIATION	ETA	ADJUSTED FOR INDEPENDENTS + COVARIATES DEV'N	BETA
SCLOCAT					
Village	573	-1.68		-0.42	
City	648	1.49	0.20	0.37	0.05
CLS					
Form 4	591	-2.12		-1.63	
Form 5	630	1.98	0.26	1.53	0.20
SEX					
Male	687	1.43		1.23	
Female	534	-1.83	0.20	-1.59	0.17
RESID					
Village	437	-1.97		-0.20	
City	784	1.10	0.18	0.11	0.02
STATUS					
Day Students	206	-1.23		-0.52	
Boarders	1,015	0.25	0.07	0.11	0.03
Multiple R <sup>2</sup>					0.298
Multiple R					0.546

TABLE 5c

INTERACTIONS TABLE FOR PERFORMANCE ON THE  
 NUMERICAL ABILITY TEST SHOWING CLASS BY  
 SEX INTERACTIONS BY SCHOOL LOCATION

		URBAN SCHOOLS		RURAL SCHOOLS	
		Class 4	Class 5	Class 4	Class 5
M A L E	N	156	187	171	187
	$\bar{X}$	18.2	24.9	16.6	21.4
F E M A L E	N	152	157	114	113
	$\bar{X}$	17.1	20.4	14.8	14.8

TABLE 5d

SPECIFIC SUBGROUP MEAN SCORES ON THE NUMERICAL ABILITY  
TEST SHOWING PATTERN OF SUBGROUP DIFFERENCES IN  
URBAN AND RURAL LOCATED SCHOOLS

	URBAN SCHOOLS			RURAL SCHOOLS		
	N	$\bar{X}$	SD	N	$\bar{X}$	SD
Entire Population	650	20.4	8.2	574	17.2	7.4
LOW SES						
Class 4						
Male	63	17.7	6.4	120	15.6	6.6
Female	59	13.3	4.4	77	15.8	7.1
Class 5						
Male	87	22.9	9.6	120	17.3	8.8
Female	54	16.1	5.3	72	14.2	4.6
MEDIUM SES						
Class 4						
Male	54	19.1	6.0	37	18.6	6.6
Female	57	15.8	6.0	32	14.2	5.7
Class 5						
Male	67	23.9	8.2	43	20.8	7.6
Female	43	18.2	7.7	23	14.8	6.2
HIGH SES						
Class 4						
Male	39	25.1	7.0	14	21.4	3.2
Female	36	20.2	7.1	5	15.0	8.4
Class 5						
Male	31	28.1	7.5	13	27.4	9.2
Female	48	25.5	9.4	7	16.0	7.8

Data Analyses Results of the Abstract Reasoning Test Performance

Table 6a gives the results of the ANCOVA for the Abstract Reasoning (AR) test. In this, as in the other tests previously discussed, the three covariates are collectively and singly significant at F-probability level of  $P \leq .001$ . The Raw Regression Coefficients for the covariates are 0.197 for WCP, 0.276 for SES, and 0.413 for General Ability. In the Main Effects Block, Class and Sex are both significant at  $P \leq .001$  level. There are three significant 2-Way interactions effect in performance on this test. Those are: Class by School Location, Sex by School Location, and School Location by Residence, all at  $P \leq .05$  level.

Table 6b is a Multiple Classification Analysis of the ANCOVA results. Both School Location and Residence have comparatively high Eta values but very low Beta values. This could be the result of their interactions with each other and with other factors. The Multiple  $R^2 = 0.316$  and  $R = 0.562$ .

Table 6c is a plot of the interactions effect of Class, Sex, and School Location. In the Urban Schools Class effect is significant for both boys and girls, but more for girls than for boys. Class difference for boys



is 2.9 points and 3.9 points for girls. In the Rural located schools, on the other hand, Class effect is significant for boys but not for girls. Sex difference within class is higher for Class IV than Class V in Urban schools, but higher for Class V than Class IV in Rural Schools.

Table 6d is a detailed breakdown of the AR test by SES by Class and Sex. It shows that combined SES and class effect is higher for girls than for boys across School Location. In the High SES level boys and girls in Class IV Urban located schools have almost equal mean scores while girls in Class V have slightly higher mean scores than boys in the same class.

With regards to the interactions of School Location and Parents' Residence, it could be said that it is likely that students who live in the Urban areas and attend Boarding schools located in Urban areas have a higher mean score than those who live in the Rural areas and attend Boarding schools located in the Rural areas.

TABLE 6a  
ANALYSIS OF COVARIANCE RESULTS SHOWING SOURCES OF GROUP  
VARIATIONS IN PERFORMANCE ON THE ABSTRACT REASONING TEST

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIG.
Covariates	39296.434	3	13098.809	179.426	***
SES	639.452	1	639.452	8.759	***
WCP	286.851	1	286.851	3.929	***
RPM	27262.180	1	27262.180	373.434	***
Main Effects	1987.992	5	3397.598	5.446	***
CLS	641.520	1	641.520	8.787	***
SEX	1218.895	1	1218.895	16.696	***
SCLOCAT	1.498	1	1.496	0.020	NS
STATUS	119.781	1	119.781	1.641	NS
RESID	6.301	1	6.301	0.086	NS
2-Way Interactions	1519.336	10	151.932	2.081	*
CLS X SEX	107.743	1	107.743	1.476	NS
CLS X SCLOCAT	289.527	1	289.527	3.966	*
CLS X STATUS	33.271	1	33.271	0.456	NS
CLS X RESID	10.249	1	10.249	0.140	NS
SEX X SCLOCAT	368.441	1	368.441	5.047	*
SEX X STATUS	7.391	1	7.391	0.101	NS
SEX X RESID	201.308	1	201.308	2.757	NS
SCLOCAT STATUS	25.703	1	25.703	0.352	NS
SCLOCAT RESID	322.750	1	322.750	4.421	*
STATUS RESID	140.227	1	140.227	1.921	NS
RESIDUAL	87750.227	1202	73.004		
TOTAL	130554.563	1220			

TABLE 6b

MULTIPLE CLASSIFICATION ANALYSIS FOR PERFORMANCE ON THE  
 ABSTRACT REASONING TEST SHOWING SUBGROUP MEAN DEVIATIONS  
 FROM THE GRAND MEAN

Grand Mean = 25.98			Number of Items = 50		
VARIABLE + CATEGORY	N	UNADJUSTED DEVIATION	ETA	ADJUSTED FOR INDEPENDENTS + COVARIATES DEV'N	BETA
SCLOCAT					
Village	573	-2.13		-0.08	
City	648	1.88	0.19	0.07	0.01
CLS					
Form 4	591	-1.44		-0.70	
Form 5	630	1.35	0.14	0.66	0.07
SEX					
Male	687	1.32		0.96	
Female	534	-1.70	0.15	-1.24	0.11
RESID					
Village	437	-2.50		0.12	
City	784	1.39	0.18	-0.07	0.01
STATUS					
Day Students	206	-1.58		-0.74	
Boarders	1,015	0.32	0.07	0.15	0.03
Multiple R <sup>2</sup>					0.316
Multiple R					0.562

TABLE 6c

INTERACTIONS TABLE FOR PERFORMANCE ON THE ABSTRACT  
 REASONING TEST SHOWING CLASS BY SEX BY SCHOOL  
 LOCATION INTERACTIONS

		URBAN SCHOOLS		RURAL SCHOOLS	
		Class IV	Class V	Class IV	Class V
	N	156	186	171	175
M A L E	$\bar{X}$	27.1	30.0	24.7	27.2
	N	152	157	114	113
F E M A L E	$\bar{X}$	24.9	28.8	20.5	20.8

TABLE 6d  
SPECIFIED SUBGROUP MEAN SCORES ON THE ABSTRACT REASONING TEST  
SHOWING PATTERN OF SUBGROUP DIFFERENCES IN URBAN  
AND RURAL LOCATED SCHOOLS

	URBAN SCHOOLS			RURAL SCHOOLS		
	N	$\bar{X}$	SD	N	$\bar{X}$	SD
Entire Population	650	27.8	10.2	574	23.9	10.0
LOW SES						
Class 4						
Male	63	24.9	10.3	120	23.4	9.9
Female	59	20.9	9.1	77	19.6	9.3
Class 5						
Male	87	27.3	10.0	120	25.7	10.5
Female	54	26.2	9.6	72	21.1	10.3
MEDIUM SES						
Class 4						
Male	54	26.8	8.7	37	24.9	8.6
Female	57	25.1	10.5	32	21.0	8.9
Class 5						
Male	67	29.7	9.8	43	28.5	11.0
Female	43	30.5	10.6	23	23.0	13.1
HIGH SES						
Class 4						
Male	39	30.0	9.8	14	28.1	8.6
Female	36	30.8	10.6	5	26.2	8.9
Class 5						
Male	31	33.8	8.9	13	30.8	8.8
Female	48	34.9	7.7	7	26.5	8.7

### Data Analyses Results of the Mechanical Reasoning Test Performance

Table 7a shows the results of the ANCOVA for the Mechanical Reasoning (MR) test. Both WCP and GA are significant at  $P \leq .001$  level, but SES is not a significant factor in performance on this test. The Raw Regression Coefficients are 0.220 for General Ability, 0.168 for WCP and 0.054 for SES. In the Main Effects Block the combined effects of all the factors is significant at  $P \leq .001$ ; also, Class and Sex are both significant at that level. There are four 2-way interactions effects at  $P \leq .01$ . Those are: Class by School Location, Class by Sex, Class by Residence and Residence by Status.

Table 7b gives the MCA of the ANCOVA for the MR test. The Multiple  $R^2 = 0.276$  and  $R = 0.526$ . That means that the factors jointly account for about 28 percent of group differences on performance in this test. The Eta and Beta values for the individual factors show that Sex is more significant a factor in this test than any of the other factors except General Ability. Sex alone accounts for about 11 percent of the group differences; the Eta value is 0.34 and Beta value is 0.33. Male students have a mean score of 32.05 while the Female students have a mean score of 26.53. That is a difference of about 6.52 points. However, further analysis according to School Location shows sex-differences to be about five points for Urban

located schools and eight points for Rural located schools in favor of boys.

Table 7c gives a breakdown of the mean scores by School Location by Class by Sex. In the Urban schools Class is significant for both boys and girls, but more for boys than for girls. And within the same class, the sex difference is wider in lower than in the higher class, reflecting the significant class effect for urban girls. In Rural located schools, on the other hand, Class is significant for boys but not for girls, this makes sex effect more significant for higher than for the lower class in this area.

Table 7d, which is a detailed breakdown of the scores by factorial groups within WCP levels show that sex difference is significant within all levels of WCP both in Urban and Rural located schools, but the gap is wider in the Rural located schools within high WCP than in the Urban schools. In the High WCP the difference between Urban boys' and girls' mean scores in Class V is 4.4, but the difference in the Rural schools is 9.4 points. The difference between Class V girls in Urban schools and Class V girls in Rural schools in High WCP is 8.0 points. Class V boys in the Rural schools have almost an equal mean score with Class V girls in Urban schools. Environment

thus confounds sex effect across School Location.

The significant interactions effects of Class, School Location, Residence, and Students' Status (i.e., Boarding versus Non-boarding) as well as the significant effect of School Location as a Main Effect, all demonstrate that performance on the Mechanical Reasoning test is very sensitive to contact with the technological culture.



TABLE 7a

ANALYSIS OF COVARIANCE RESULTS SHOWING SOURCES OF GROUP VARIATIONS  
IN PERFORMANCE ON THE MECHANICAL REASONING TEST

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIG
Covariates	12553.586	3	4221.195	92.136	***
SES	6.221	1	6.221	0.136	NS
WCP	1056.101	1	1056.101	23.052	***
RPM	7695.813	1	7695.813	167.977	***
Main Effects	8977.961	5	1795.592	39.193	***
CLS	866.461	1	866.461	18.912	***
SEX	7564.246	1	7564.246	165.105	**
SCLOCAT	379.828	1	379.828	8.291	*
STATUS	65.872	1	65.879	1.438	NS
RESID	101.547	1	101.541	2.216	NS
2-Way Interactions	1624.543	10	162.454	3.546	***
CLS X SEX	246.917	1	246.917	5.389	**
CLS X SCLOCAT	292.916	1	292.916	6.394	*
CLS X STATUS	17.134	1	17.134	0.374	NS
CLS X RESID	83.024	1	83.024	1.812	NS
SEX X SCLOCAT	44.340	1	44.340	0.968	NS
SEX X STATUS	80.243	1	80.243	1.751	NS
SEX X RESID	147.673	1	147.673	3.223	NS
SCLOCAT X STATUS	282.829	1	282.829	6.173	*
SCLOCAT X RESID	4.756	1	4.756	0.104	NS
STATUS X RESID	372.378	1	372.378	8.128	*
RESIDUAL	55069.223	1202	45.815		
TOTAL	78335.313	1220	64.209		

TABLE 7b

MULTIPLE CLASSIFICATION ANALYSIS FOR PERFORMANCE ON THE  
MECHANICAL REASONING TEST SHOWING SUBGROUP MEAN  
DEVIATIONS FROM THE GRAND MEAN

Grand Mean = 29.64			Number of Items = 70		
VARIABLE + CATEGORY	N	UNADJUSTED DEVIATION	ETA	ADJUSTED FOR INDEPENDENTS + COVARIATES DEV'N	BETA
SCLOCAT					
Village	573	-1.61		-0.68	
City	648	1.43	0.19	0.60	0.08
CLS					
Form 4	591	-1.29		-0.85	
Form 5	630	1.21	0.16	0.80	0.10
SEX					
Male	687	2.41		2.33	
Female	534	-3.11	0.34	-3.00	0.33
RESID					
Village	437	-1.43		0.49	
City	784	0.80	0.13	-0.27	0.05
STATUS					
Day Students	206	-0.30		-0.57	
Boarders	1,015	0.06	0.02	0.12	0.03
Multiple R <sup>2</sup>					0.276
Multiple R					0.526

TABLE 7c

INTERACTIONS TABLE FOR PERFORMANCE ON THE MECHANICAL  
REASONING TEST SHOWING CLASS BY SEX BY SCHOOL LOCATION INTERACTIONS

		URBAN SCHOOLS		RURAL SCHOOLS	
		Class 4	Class 5	Class 4	Class 5
M A L E	N	156	187	171	175
	$\bar{X}$	31.7	36.6	29.4	31.2
	N	152	157	114	113
	$\bar{X}$	26.7	29.3	24.6	24.5

TABLE 7d

SPECIFIED SUBGROUP MEAN SCORES ON THE MECHANICAL  
REASONING TEST SHOWING PATTERN OF SUBGROUP DIFFERENCES  
IN URBAN AND RURAL LOCATED SCHOOLS

	N	$\bar{X}$	SD	N	$\bar{X}$	SD
Entire Population	650	31.1	7.9	574	28.2	7.7
LOW WCP						
Class 4						
Male	63	30.6	6.0	120	27.5	7.5
Female	59	25.1	7.7	77	23.1	5.9
Class 5						
Male	87	34.2	6.8	120	30.4	5.6
Female	54	27.4	5.1	72	24.7	7.0
MEDIUM WCP						
Class 4						
Male	54	30.8	6.5	37	29.9	8.6
Female	57	25.7	5.2	32	25.2	6.5
Class 5						
Male	67	37.2	6.6	43	32.7	7.9
Female	43	30.0	5.8	23	26.0	5.9
HIGH WCP						
Class 4						
Male	39	35.6	7.9	14	33.7	6.7
Female	36	31.2	5.7	5	25.5	2.1
Class 5						
Male	31	38.9	8.8	13	34.8	7.6
Female	48	34.4	7.6	7	26.4	3.6

### Data Analyses Results of the Space Relation Test Performance

Table 8a is an ANCOVA table for performance on the Space Relations (SR) test. As in the MR test, SES is not a significant factor in performance in this test. WCP and General Ability are both significant at  $P \leq .001$  level. The Raw Regression Coefficients for the Covariates is 0.213 for GA, 0.108 for WCP, and 0.061 for SES. In the Main Effects Block, the combined effects of the factors is significant at  $P \leq .001$  but only Sex is significant at that level among all the factors in this block. Class is significant at  $P \leq .03$  level and none of the other factors is significant. It is observed that School location has less effect on performance on this test either as a main effect or through interactions than in the other tests. The Multiple  $R^2 = 0.245$ , and  $R = 0.495$ .

Table 8b is the Multiple Classification Analysis for the details of the ANCOVA results. The Eta values for Sex and Residence are the same but the Beta value for Residence is comparatively lower than it is for Sex. Also, School Location has a higher Eta value than Sex, but a much lower Beta value than Sex. Thus Sex has more effect on group performances in this test than the other categorical factors. It is observed that the value of the Multiple  $R^2$  which represents the percentage of the dependent variable

(in this case, performance on the Space Relations test) accounted by the independent variables, is smallest in this test compared to its value in the other tests. This could suggest that performance on the Space Relations might depend on some other unidentified variable(s) more than do the other tests. This point, however, needs further investigation especially as some psychologists, Dawson (1967) for example, suggest that spatial-perceptual ability among African subjects could depend more on Witkin's (1954, 1962) theory of "field-dependence" than on exposure to Western culture.

Table 8c gives a breakdown of the scores according to the various subgroups within the different levels of Western culture participation (WCP). As in the Mechanical Reasoning test, scores in the Space Relations test increases with increasing level of WCP but with lesser number of points (particularly in the rural located schools) than is the case in the MR test.

TABLE 8a  
ANALYSIS OF COVARIANCE RESULTS SHOWING SOURCES OF GROUP  
VARIATIONS IN PERFORMANCE ON THE SPACE RELATIONS TEST

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIG.
Covariates	11475.543	3	3825.181	122.466	***
SES	49.550	1	49.550	1.586	NS
WCP	429.006	1	429.006	13.735	***
RPM	7255.992	1	7255.992	232.306	***
Main Effects	827.520	5	165.504	5.299	***
CLS	153.785	1	153.785	4.924	*
SEX	578.395	1	578.395	18.518	***
SCLOCAT	20.781	1	20.781	0.665	NS
STATUS	5.254	1	5.254	0.168	NS
RESID	69.305	1	69.305	0.219	NS
2-Way Interactions	447.672	10	44.767	1.433	NS
CLS X SEX	10.112	1	10.112	0.324	NS
CLS X SCLOCAT	51.846	1	51.846	1.660	NS
CLS X STATUS	1.259	1	1.259	1.040	NS
CLS X RESID	7.708	1	7.708	0.247	NS
SEX X SCLOCAT	58.766	1	58.766	1.881	NS
SEX X STATUS	98.632	1	98.632	3.158	NS
SEX X RESID	53.212	1	53.212	1.704	NS
SCLOCAT X STATUS	2.133	1	2.133	0.068	NS
SCLOCAT X RESID	113.153	1	113.153	3.623	*
STATUS X RESID	0.003	1	0.003		NS
RESIDUAL	37544.020	1202	31.235		
TOTAL	50294.754	1220	41.225		

TABLE 8b

MULTIPLE CLASSIFICATION ANALYSIS FOR PERFORMANCE ON THE  
SPACE RELATION TEST SHOWING SUBGROUP MEAN DEVIATIONS  
FROM THE GRAND MEAN

Grand Mean = 18.40		Number of Items = 60			
VARIABLE + CATEGORY	N	UNADJUSTED DEVIATION	ETA	ADJUSTED FOR INDEPENDENTS + COVARIATES DEV'N	BETA
SCLOCAT					
Village	573	-1.30		-0.15	
City	648	1.15	0.19	0.13	0.02
CLS					
Form 4	591	-0.75		-0.39	
Form 5	630	0.71	0.11	0.37	0.06
SEX					
Male	687	0.83		0.62	
Female	534	-1.07	0.15	-0.80	0.11
RESID					
Village	437	-1.31		0.41	
City	784	0.73	0.15	-0.23	0.05
STATUS					
Day Students	206	-0.30		0.13	
Boarders	1,015	0.06	0.02	-0.03	0.01
Multiple R <sup>2</sup>					0.245
Multiple R					0.495



TABLE 8c

SPECIFIED SUBGROUP MEAN SCORES ON THE SPACE RELATION TEST  
 SHOWING PATTERN OF SUBGROUP DIFFERENCES IN  
 URBAN AND RURAL LOCATED SCHOOLS

	URBAN SCHOOLS			RURAL SCHOOLS		
	N	$\bar{X}$	SD	N	$\bar{X}$	SD
Entire Population	650	19.6	6.8	574	17.1	5.6
LOW WCP						
Class 4						
Male	63	16.9	6.3	120	16.5	5.0
Female	59	15.6	5.3	77	14.7	4.3
Class 5						
Male	87	20.7	4.9	120	17.0	5.2
Female	54	17.1	3.9	72	16.9	5.2
MEDIUM WCP						
Class 4						
Male	54	19.4	5.9	37	17.8	5.8
Female	57	16.4	5.3	32	16.1	5.4
Class 5						
Male	67	21.0	6.8	43	18.7	6.2
Female	43	19.6	5.6	23	16.9	4.7
HIGH WCP						
Class 4						
Male	39	22.7	7.0	14	19.1	2.8
Female	36	20.9	7.0	5	17.5	3.5
Class 5						
Male	31	25.3	9.2	13	22.5	7.2
Female	48	22.7	7.0	7	20.2	4.3

### Data Analyses Results of the Raven's Progressive Matrices Performance

In view of the fact that the Raven's Progressive Matrices was developed in the advanced technological culture for assessment of General Mental Ability to learn, it was of interest to see how the other factors used as independent variables for the other aptitude tests affect the development of this ability among Nigerian students. An analysis of Covariance was therefore performed with RPM as the dependent variable and the other factors as independent variables.

Table 9a presents the results of the analysis. It shows that SES and WCP are significant sources of group variance but both have low Regressional Coefficient. This could mean that they both interact. However, SES is significant at  $P \leq .001$  while WCP is significant at  $P \leq .01$ . In the Main Effects Block, Class, Sex, and School Location are all significant at  $P \leq .001$ . There is only one significant interactions effect, and that is Class by Parents' Residence at  $P \leq .05$  level.

Table 9b shows a plot of the interactions effect. It gives a breakdown of the mean scores according to Parents' Residence by Class. The results show that class difference is more significant for students living in Rural areas than those living in Urban areas.

The fact that the effect of socio-economic status is significant at a higher level of probability than that of Western culture participation in performance on this test could suggest that development of ability to see relations in general, in the terms of Western culture, which is what RPM is said to measure, is affected by nutritional factors. However, the significant effect of School Location suggests that technological environment is also an important factor in performance on this test. The significant interactions effect of Class and Residence in which Class effect is higher in the rural than for the urban residents, confirms this. For the rural residents (especially if they attend schools located in their residential areas) higher number of school years would be the only source of Western culture contact through books and lectures. In that case its effect on the test performance is greater for the rural residents than for the urban residents which provides other sources of Western culture-contact. Thus the difference between the scores of Classes IV and V students on the RPM is about seven points for rural residents and only about three points for the urban residents.

These results confirm the findings in other parts of Africa that scores on the Raven's Progressive Matrices is a function of number of years of schooling (Dague 1972).

Another way of interpreting this is that, it could be that what the RPM measures is fundamental to the Western system of education. In that case it could be a good predictor for higher scholastic ability among the Africans, when the influence of cultural and environmental factors are controlled. However, this will require further investigation.

Table 9c gives a detailed breakdown of the RPM mean scores of subgroups within different levels of SES. The breakdown is done according to school location. The differences between the mean scores of students in the same SES level but in different levels of other categories would be due to the effects of those factors. Thus performance on this depends on a number of other factors such as sex, and modern-culture environment, in addition to high socio-economic home.

It is observed that in the Urban located schools, within high SES level, girls in both Classes IV and V have higher mean scores than boys in the same categories. This indicates that given same home background and equal exposure to modern culture, girls in Nigeria would perform as well as, or might perform better than boys in the Raven's Progressive Matrices.

TABLE 9a  
ANALYSIS OF COVARIANCE RESULTS SHOWING SOURCES OF GROUP VARIATIONS  
IN PERFORMANCE ON THE RAVEN'S PROGRESSIVE MATRICES

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIG.
Covariates	14280.371	2	7140.184	59.841	***
SES	2885.852	1	2885.852	24.186	***
WCP	894.363	1	894.363	7.496	**
Main Effects	14189.609	10	1418.961	11.892	***
CLS	2192.586	1	2192.586	18.376	***
SEX	4389.348	1	4389.348	36.787	***
SCLOCAT	7139.918	1	7139.918	59.830	***
RESID	0.234	1	0.234	0.002	NS
2-Way Interactions	4581.375	29	157.978	1.324	NS
CLS X SEX	0.064	1	0.064	0.001	NS
CLS X SCLOCAT	0.201	1	0.201	0.002	NS
CLS X RESID	1100.983	1	1100.983	9.227	*
SEX X SCLOCAT	344.079	1	344.079	2.884	NS
SEX X RESID	83.393	1	83.393	0.699	NS
SCLOCAT RESID	219.190	1	219.190	1.837	NS
RESIDUAL	141154.438	1183	119.319		
TOTAL	174205.813	1224	142.325		

TABLE 9b

INTERACTIONS TABLE FOR PERFORMANCE ON THE RAVEN'S  
PROGRESSIVE MATRICES SHOWING CLASS BY RESIDENCE INTERACTIONS

		URBAN RESIDENCE	RURAL RESIDENCE
C L A S S   I V	N	361	232
	$\bar{X}$	36.6	28.8
C L A S S   V	N	427	205
	$\bar{X}$	39.3	35.6

TABLE 9c

SPECIFIED SUBGROUP MEAN SCORES ON THE RAVEN'S PROGRESSIVE  
 MATRICES SHOWING PATTERN OF SUBGROUP DIFFERENCES IN  
 URBAN AND RURAL LOCATED SCHOOLS

	URBAN SCHOOLS			RURAL SCHOOLS		
	N	$\bar{X}$	SD	N	$\bar{X}$	SD
Entire Population	650	39.0	10.9	574	32.2	11.9
LOW SES						
Class 4						
Male	63	38.2	9.3	120	31.8	11.4
Female	54	33.7	9.7	77	26.4	12.3
Class 5						
Male	87	38.9	10.4	120	34.4	10.7
Female	54	35.1	10.7	72	29.9	11.2
MEDIUM SES						
Class 4						
Male	54	39.0	9.1	37	35.6	12.2
Female	57	34.8	10.1	32	29.9	10.9
Class 5						
Male	67	42.7	8.7	43	38.7	9.7
Female	43	39.6	9.8	23	30.4	12.0
HIGH SES						
Class 4						
Male	39	40.6	10.0	14	36.2	11.1
Female	36	42.5	10.6	5	33.4	10.1
Class 5						
Male	31	42.4	9.8	13	41.6	11.1
Female	48	44.6	9.3	7	35.6	10.1

## CHAPTER VII

### DISCUSSION

#### General Discussion

The present study has shown that in general, both cultural and environmental factors affect the performance of Nigerian students on the various types of "ability" tests developed in the advanced technological countries. These tests include both verbal and non-verbal, "culture-fair" as well as "culture-loaded" types, but it would appear that they all require one basic skill according to Spearman's findings, explained by Jensen (1969).

Jensen (1969) explained that Spearman, through factor analysis technique observed that all tests which call for complex and higher mental activities, irrespective of whether they measure ability to deal with abstract figures, or space relations, numerical problems or verbal analogies, have one common factor underlying them. He designated this factor as "general intelligence" or "g," and he described this factor as the ability to educe relations and correlates. Mehrens and Lehman (1969)



stated that one way of distinguishing between general intelligence and Aptitude tests is to assess the position of each test on a continuum of the Spearman's "g." Those containing a high component of "g" would be regarded as general intelligence tests while those with low "g" content would be regarded as Aptitude tests. Among the tests Mehrens and Lehman classified as general ability tests is the Raven's Progressive Matrices, while the specific Aptitude tests include the Differential Aptitude Tests (DAT). However, within the DAT battery, the tests authors explain that the Verbal Reasoning, Numerical Ability, and the Abstract Reasoning tests measure those functions which are associated with general ability that is scholastic aptitudes or "intelligence."

Thus it appears that all "ability" tests developed in the advanced technological societies are anchored on this one general factor - "intelligence." The concept of intelligence has generated so much controversy among psychologists and educationalists with regards to its definition, but in general, the term seems to be synonymous with the idea of survival within a technological culture. Rusen (1975), discussing the social dimensions of the concept of intelligence, explained that adaptation to modern civilization depends, to an increasing extent, on ability to operate with verbal and numerical symbols, hence,

according to him, "ability" or "intelligence" is measured accordingly. He argues that since modern civilization is an outcome of "symbolic behavior" that "intelligence" should be defined as the ability to operate symbols not only in schools but in working life and in a technological society at large.

It could be said that Husen's idea of intelligence is an underlying factor in any "ability" test developed in Europe and America. It is the fact that modern civilization is an outcome of a "symbolic behavior" as explained by Husen (1975), and the fact that African traditional culture lacks much of this symbolic characteristics that the performance of African people on tests developed in the advanced technological countries to measure "ability to Learn" depend on, among other things, one's level of Western culture-contact, especially through the Western form of education. This would explain why performance on a test like the Raven's Progressive Matrices (RPM), whose items are described as "meaningless figures" by Raven (1960), is a function of level of number of years of schooling among African samples (Dague 1972). The required skill, which is ability to "educe" relations, is more a product of the technological culture than of the African traditional culture. The results of the present study have also

confirmed that fact. It was observed that, on the whole, Nigerian students in schools located in the urban areas performed significantly better in all the tests than students in schools located in the rural areas. It has been pointed out that urban and rural environments in Nigeria have distinct contrasting features; the urban environment has more elements of a technological culture while the rural environment lack these features. Similarly, social attitudes within the two environments differ, especially on girls' education and freedom of movement. These environmental and social differences reflected on the level of development of aptitudes, which are products and essentials of the technological culture, by students under the influence of the two different cultural environments. The cultural differences also reflected on the different patterns of "sex-differences," (on the Nigerian students' performance on the selected ability tests) observed in the urban and rural located schools. These points will be elaborated as the effect(s) of each or group of the specified cultural and environmental factors on the students' performance on the tests is discussed in the subsequent sections.

The Effects of Socioeconomic Status (SES) and Western Culture Participation (WCP) on the Nigerian Students' Performance on Western-Developed Aptitude Tests

According to the results of the ANCOVA, in four of the tests, namely, the Verbal Reasoning, Numerical Ability, Abstract Reasoning, and the Progressive Matrices, both SES and WCP are significant sources of group differences. In the Mechanical Reasoning and Space Relations tests WCP is also a significant factor in students' performance but SES is not a significant factor as shown by the results.

It is noticed that in the four tests in which both SES and WCP are significant sources of group differences, SES has higher Raw (score) Regression coefficients than WCP. The size of the Regression Coefficient, say  $B_1$ , is a regression equation such as,  $Y=A+B_1X_1+B_2X_2+....B_nX_n$ , represents the expected difference in Y between two groups which are different on  $X_1$  by one unit but are equal in all the other factors. In the Analysis of Covariance the three covariates, SES, WCP and General Ability (RPM scores), all of which are measured at interval scale, are processed, (according to the computer program) as variables in a Regression Analysis. Thus a higher coefficient for SES than WCP in performance in any of the tests suggests that, in the event of predicting performance on that particular test, a difference of one unit of SES between groups would

produce a larger change in  $Y^1$  (the predicted score) than a unit difference of WCP would.

On the basis of the above explanation, it would be said that, of the three covariates used in the analysis, that General Ability (RPM scores) contributed far more than either SES or WCP to performance in all the tests. This, however, is not surprising, in view of the fact that "ability to see relations" which is what the RPM scores in essence measure, underlines each of the tests.

It is rather interesting to note that the four tests in which SES is a significant factor in the Nigerian students' performance include the tests described either as "scholastic aptitude" tests, (Verbal Reasoning and Numerical Ability tests) or "general ability" tests (Abstract Reasoning, and Raven's Progressive Matrices). And that SES Regression Coefficients are highest in the last two mentioned tests. These results, however, conform with the findings of some other studies in which social class difference is a significant factor in performance on general ability and scholastic aptitude tests.

For example, Bakare (1972) found social class differences in the performance of Nigerian students on the Goodenough-Harris Draw-A-Man (DAM) test. The DAM test

is described as a general intelligence test. Bakare ascribed the SES difference to lack of stimulating environment as well as mal-nutrition on the part of the low SES children. Anastasi (1965) discussing social class differences on performance on general intelligence tests, argued that part of such differences could be that the items of such tests have "in-built" skills associated with the high SES group in a Western society, and which skills also are required for success in school works. These skills include verbal and numerical abilities. It would appear that these skills are associated with high SES because social class is usually measured by Father's level of education or occupation in the Western societies. In the present study, an attempt was made to include more attributes in the concept of SES in view of the operating social climate in Nigeria according to the explanations in Chapter III. However, it cannot be ruled out that Father's educational and occupational levels which formed part of the composite SES index used in this study played a major role in the Nigerian students' performance on the Verbal Reasoning and Numerical Ability tests. Under that situation high SES students would perform better on these tests than the low SES students.

However, one would wonder why there is significant socio-economic effect on the students' performance on the

Abstract Reasoning test and the Raven's Progressive Matrices. The items of these two tests were composed of "meaningless" figures and students were required to detect existing relations between a given diagram and a set of suggested alternative diagrams. Why would high SES students perform better than low SES students in these tests since the items of these tests were not related to anything found in specific home environments? A possible explanation would be that the socioeconomic difference on the tests performance do not stem from the items of the tests per se, but rather they exist in the amount of basic ability to "see relations" developed by students from the high and low socioeconomic levels. One might suggest that the development of this ability is, most probably, associated with nutritional factors which students from low SES lack. This suggestion is supported by the fact that when students were matched according to school location, sex, class, and SES, it was observed that Class V students in high SES scored higher than their counterparts in low SES by at least six points in both urban and rural located schools in the tests under discussion.

The fact that socioeconomic status is not a significant factor in Nigerian students' performance on the Mechanical Reasoning and Space Relations tests, even if at a low level of probability, appears a bit puzzling.

This is in consideration of the fact that these two tests, as well as the others, measure, among other things, "general ability to see relations." It could mean that these tests measure more of something else which the SES scale has not tapped, that is, the skill to transfer basic ability to "see relations" into specific areas of learning depend more on some other environmental factors than are measured by the SES index.

The items of the MR and SR tests are such that performance in them would require, among other things, familiarity with the technological objects on which they are based. Since most of these objects are not found in Nigerian homes, students' contact with them depend on other sources of Western culture-contact. In any case the study has confirmed that Western culture participation is a major factor in the Nigerian students' performance in these two tests in particular, and it appears that a student's "participation," as measured in this study, does not solely depend on the socio-economic status of the parents.

#### Urban - Rural Effect on Western-Developed Aptitude Tests Performance in Nigeria

Urban - Rural environments are measured in this study by School Location, and Parents' Residence. The reason for including both factors is to examine which of



them is more significant in performance of students on specific or all the tests, since both are sources of modern culture contact. The Analysis of Covariance showed that School Location is significant for a greater number of tests than is Residence, either as a main effect or through interactions with other factors. The processing procedure of the ANCOVA sub-program used assessed the effect of each factor as well as their interactions while holding the other factors, including the covariates, constant. The Multiple Classifications Analysis (MCA) show that School Location contributed more than Residence to group differences in performance on all the tests. The fact that students' school environment more than their residential areas is a stronger influence on their performance on these aptitude tests could be due to the fact that more than 80 percent of schools in Nigeria are boarding schools. Secondary school students spend at least two thirds of each year of their secondary school period in their schools rather than in their homes.

However, Urban-Rural effect in this study is in a way an endorsement of the importance of Western culture participation in the performance of Nigerian students in these aptitude tests. This point is confirmed by the significant interactions effect of Class by School Location, School Location by Status (boarding vs. non-

boarding), Status by Residence, and School Location by Residence, in some of the tests such as the Mechanical Reasoning tests. All these factors are sources of Western culture contact. Students who live in urban areas and attend boarding schools located in the urban areas have greater exposure to technological culture than those in the opposite categories.

It could be said that urban-rural on students' ability tests performance in Nigeria is due to, not only environmental differences in terms of availability of technological objects, but also due to cultural differences between the two different cultures associated with each of the areas under discussion. This suggestion could be supported with the fact that when students were matched according to the other specified social and environmental factors such as sex, class, socioeconomic status and Western culture participation, it was observed that students in the urban located schools in each level of a given category scored higher than their counterparts in the rural located schools. Such social factors would include expected sex-role, particularly in case of girls, it would also include type and level of motivations inspired by attitudes and beliefs in each area. This point, however, would require further research studies.

The Effect of Number of Years of Schooling (Class) on  
Nigerian Students' Performance on Western-Developed  
Aptitude Tests

Analysis of the data has shown that in all the tests Class is a significant factor in students' performance. The importance of number of years of schooling measured by Class in this study lies in the fact that in Nigeria, as well as in some other African countries, the school is the main source of Western cultural contact; for most students it is the only source. The students whose parents are farmers in the villages and they themselves attend schools located in the villages, depend almost exclusively on the school for whatever technological cultural experience they acquire. This would be mainly through text books and lectures since in many cases such schools lack the modern school equipment.

However, the significant differences observed in the performance of two adjacent classes of IV and V in a test such as the Mechanical Reasoning test, in the urban located schools, could indicate that Nigerian students in the urban areas are not interacting with their environment informally as much as they should. In that case their performance on such a test would be more influenced by the level of their formal education. This statement becomes obvious when one compares the mean-score difference between Grades 11 and 12 in American schools (used to

establish Norms for the DAT battery) on the MR test which is less than two points for male students in those classes to a mean-score difference of about five points between Classes IV and V boys in urban located schools in Nigeria. The differences are less for girls in both American and Nigerian cases in this test.

One would have been tempted to say that performance on the DAT tests depend on number of school years (measured by class) since the DAT battery is normed by Grades. However, this could be more of age effect than years of schooling. In the advanced countries it is usual to treat students on age bases with regards to development of abilities. The reason is that development of some cognitive abilities such as verbal and numerical skills, for example, are associated with physical maturation (Maccoby, 1976). In any case, it is easier in such countries where education is compulsory for all children and where there is automatic promotion at the end of school years to keep track of students' age than it is in Nigeria where education is not yet compulsory for all children and children start school at various ages. Besides, promotion at the end of a school year is not automatic, as such; some students spend longer years in school than others. In one class there would be students of various ages. However, in view of previous discussions

in this paper, it is most likely that the development of "abilities" in terms of technological culture among African subjects would depend more on degree of contact with the Western culture than on age.

Sex-Differences in the Performance of Nigerian Students on The Various Types of Aptitude Tests Used in the Present Study

The results of the Analysis of Covariance show that in all the aptitude tests there are significant effects of Sex in the Nigerian students' performance. Sex differences are more pronounced in the Numerical Ability, Mechanical Reasoning, and Space Relations tests. Sex effect in these tests are significant for both urban and rural located schools. In the Verbal Reasoning and Abstract Reasoning tests, detailed analysis show that Sex difference is significant for schools located in the rural areas and not for urban located schools. On matching students according to SES or WCP levels, Class, and Sex, within different School Locations, it was observed that in urban located schools, class V girls in High SES level have the same mean scores with boys in the same categories on the Verbal Reasoning test. In the Abstract Reasoning test as well as in the Raven's Progressive Matrices, the girls in the categories described above have slightly higher mean scores than boys in the same categories. (Tables 4d, 6d, and 9c.)

These results to some extent agree with some other research findings. Lesser (1964) reviewed and summarized a number of research studies which compared the performances of boys and girls on some mental ability tests. He observed that the studies of Herberg and Lapkin (1954) and that of Witkin (1954) among others show that girls perform better than boys on tests measuring verbal or language skills, but that the girls' superiority on such tests is outstanding only on items which measure Word Fluency, while boys do equally well or better on items that measure Verbal Analogy. Also, the studies of Terman and Tyler, (1954) among others, show that boys perform better than girls on Arithmetic problems and numerical reasoning tests. According to Lesser's (1964) review, Sweeny (1953) observed that boys are significantly superior than girls in problems calling for "restructuring." Similarly, Kostik (1954) stated that boys have more ability than girls to transfer or to apply skill and knowledge to new situations.

Maccoby (1976) attributed sex differences in verbal ability tests in favor of girls to a result of earlier identification of girls with their adult-models (i.e., their mothers). According to Maccoby's explanation, since mothers stay home more than fathers, girls identify

earlier with their model's interests such as housework and thereby have closer adult-interaction earlier than boys. This sort of explanation, however, would be more applicable in a situation in which the language under consideration is the child's "mother tongue." In the present study, the verbal test is in the English language hence sex-difference in the test is confounded by cultural and environmental differences. Irvine (1966) observed that in East Africa, males have a verbal advantage in all tests in which English is the medium. He attributed the reason to what he described as the "social mobility of males" in Central African societies which leads to increasing social dominance achieved by such mobility. He explained that in school work boys are encouraged more than girls to succeed because boys are considered to have more responsibility than girls in the societies. This same social discriminatory attitude towards girls' education exists in Nigeria and it is more pronounced in the traditional than in the modern culture. This would account for significant Sex by School Location interactions in the Abstract Reasoning test and the Raven's Progressive Matrices. Expected sex-role is likely to affect the development of "general ability" by some Nigerian girls. Bakare (1972), found a significant sex-difference in favor of boys in the performance of Nigerian children on the

Harris' Draw-A-Man test which is regarded as a "general intelligence" test. Bakare offered no explanations but commented that the finding was contrary to other research studies which found sex-difference in favor of girls in the test, such as that of Alzobaie (1965). (This study was conducted at Iraq.) However, the results of the detailed analysis in the present study have shown that Nigerian girls, under the influence of the modern culture could perform at least as well as boys in verbal and general intelligence tests.

Sex differences in performance in numerical, mechanical and spatial ability tests are attributed to a number of factors. Maccoby (1976) attributed the differences in favor of boys in these tests as a result of greater freedom and opportunity for boys to explore their environment. She also feels that part of the reason is the effect of sex-typed interests which is fostered in children by exposure to their adult-models. Thus girls would see themselves in terms of their mother's interests such as housework, teaching, nursing, secretarial work and such woman-like jobs. Similarly, boys would think of themselves as engineers, accountants, scientists, pilots, and such man-like jobs. This explanation would apply in the Nigerian society of both traditional and modern cultures.



In research study done by Abiri (1976) on the Nigerian Adolescents' Academic and Occupational Aspirations, he observed that none of the girls in the sample of 1,254 students chose a career in engineering, and that a negligible percentage of the girls indicated their interest to do a higher study in science fields. Most of the girls chose nursing and teaching while none of the boys indicated interest in nursing careers. Such sex-typed interests may be partly responsible for the results of the present study.

On the whole, the present study has demonstrated that given equal opportunity, girls in Nigerian secondary schools would perform equally well as boys in Verbal Reasoning, and Abstract Reasoning tests, but that boys will perform better than girls in Mechanical Reasoning, Numerical Ability, and Space Relations tests. This conclusion, however, only applies to schools located in the urban areas, since in the rural areas boys performed significantly better than girls in all the tests. This point is discussed further in the next section.

### General Conclusions

Following the results of the data analysis of the present study, the following conclusions can be made: that at the present stage of technological development in Nigeria;

1. students' performance on the Differential Aptitude Tests (DAT) battery, as well as on the Raven's Progressive Matrices (RPM), depends, in general, on individual level of Western culture participation (WCP).
2. performance on the Verbal, Numerical, and Abstract Reasoning ability tests as well as on the RPM depends on both SES and WCP, but more on SES than on WCP.
3. performance on Mechanical Reasoning and Space Relations tests depends on WCP, not on SES.
4. in general, boys would perform significantly better than girls in Numerical, Mechanical, and Spatial ability tests.
5. in the Urban located schools, there would be no significant differences in the performance of boys and girls on the Verbal and Abstract Reasoning tests as well as on the RPM.
6. in the Rural located schools, boys would perform significantly better than girls in all the tests including the verbal, abstract reasoning tests, as well as on the RPM.

7. both boys and girls in Urban located schools would perform significantly better in all the ability tests than their counterparts in the Rural located schools.

The present study has thus shown how cultural and environmental factors peculiar to a given society could affect the specific details of general theories. For example, research studies conducted in the Western societies, as has already been pointed out, observed that, in general, girls tend to perform better than boys in tests that require verbal or language skills, while boys perform better than girls in tests which involve numerical, mechanical and spatial abilities. It is also observed that there are no significant differences in the performance of boys and girls in abstract reasoning tests. Such general conclusions about pattern of sex-differences in performance on aptitude tests would apply only to Nigerian students attending schools located in the "urban" areas according to the results of the present investigation.

The results of the present study have shown that in Nigeria, at its present stage of technological industrialization, there exists two different patterns of sex-differences on students' performance on Western

developed aptitude tests. That is, that in the rural located schools boys would perform better than girls in all the types of aptitude tests used in this study. In the urban located schools, on the other hand, while boys would perform better than girls in tests that require mechanical and spatial skills, there would be no significant differences in the performance of boys and girls in verbal and abstract reasoning tests, including the Raven's Progressive Matrices. The general trend of the results of the present study in which students of both sexes in the urban located schools performed significantly better than their counterparts in the rural located schools in all the tests could be attributed to environmental differences, but the differences in pattern of results within each environment would appear to be due to cultural factors, such as expected sex-role which differs in the present Nigerian traditional culture (associated with the rural communities), and modern culture (associated with the urban communities).

The rural communities in Nigeria live under the predominant influence of the Nigerian traditional culture with its pronounced differential treatments between boys and girls in matters of social responsibilities and consequently, educational opportunities and expectations. Such social attitudes could affect the levels of aptitudes,

of all types, developed by girls attending schools located in such communities (when compared to those of boys in the same environment) if they see their role in the society as that of subordinates. The urban communities, on the other hand, maintain a more liberal attitude towards the expected social roles and educational opportunities of both boys and girls. This fact is reflected in the pattern of sex-differences in the results of students attending urban located schools. The pattern is more like the situations which are obtained in Western societies. The contrasting cultural and environmental factors which exist in Nigeria, at the present time, between the urban and rural communities, and the fact that the Nigerian government operates a Western system of education in both urban and rural areas, have problematic educational and manpower development consequences. This will be elaborated on in the next section.

#### Educational Implications and Recommendations

The implication of the results of the present study is that if the DAT battery tests are used for selective purposes in Nigeria, they would discriminate against students who attend secondary schools located in the rural areas, unless a separate norm is provided for these group of students. Similarly, if they are used for counselling purposes on a national norm, they might lead to series of

wrong decisions with regards to academic and vocational choices, especially in the rural areas. On the other hand, with adequate precautions, such as provision of separate norms for identifiable subgroups, the tests could be utilized for counselling purposes in Nigeria.

However, the efficacy of separate norms would be enhanced by further research studies to determine how these specified differentiating social and environmental factors (moderator variables) would affect the "predictability" of each subgroup with the various types of aptitude tests. Such investigations would lead to an establishment of expected validity coefficients with regards to the factors specific to a given group. It would also lead to the use of regression weights and cut off scores to determine the predictive validity of a given test for each cultural subgroup for a specific educational or job criterion or group of criteria. This will lead to an effective utilization of the aptitude tests for classification and placement counselling in Nigeria.

Another implication of the results of the present study is that the siting of post-primary institutions in the rural areas in the present Nigerian cultural situation is not a good educational policy. In view of the increasing emphasis on Western technology in the country, it would be

in the interest of both the students and the country if secondary schools at least, are located in the urban areas where students will have more opportunities to interact with the technological objects. The results of the present study have shown that performance of Nigerian students on some specific aptitude tests, such as the Mechanical and Spatial aptitude tests depend almost entirely on Western culture contact. In that case, unless the Nigerian government adopts the policy of siting secondary schools in urban areas or makes a strong effort to provide technological features for the rural areas, students who live and attend schools in the rural areas where the environment is anything but technological, would be at a disadvantage when such abilities are assessed with tests developed in technological cultures. This type of situation tends to limit the scope of vocational and even academic choices of students from the rural areas. This does not only introduce some elements of social injustice, it also would affect the availability of the required manpower for effective and successful transformation of the present Nigerian culture into a high level technological culture.

With regards to the production of an effective manpower which would bring about a successful transformation of the present Nigerian culture or sustain it when it is

transformed, one would say that Nigerian students on the whole need to be stimulated into getting sufficiently involved with the technological objects around them outside their classrooms. The fact that Western education originated in a culture foreign to the traditional African culture, creates a loose link between it and normal life for most of the African students. Except in the technical schools in which students have the opportunity to interact or manipulate some of the technological objects, most students in grammar schools in Nigeria, for example, depend on their text books and lectures (and science laboratories for those who have them) for much of their contact with modern technological objects. Very few homes provide adequate opportunities for such necessary contacts. The result of this is that even in the urban areas where these technological objects exist, since the home environments do not provide enough stimulation for the majority of the children, the mere existence of these technological objects in the urban areas might not generate enough interest and curiosity in the students to explore these objects in a way that would give them enough insight into the mechanisms of the objects. Mere reading about them or seeing them casually is not enough. High level of aptitude in other areas or for theoretical work from text books may not compensate for lack of physical inter-



action with mechanical objects in understanding the mechanisms of the modern technological gadgets. In the advanced technological societies children interact with their environment from an early age; even the toys they play with reflect modern technological mechanisms. The result of this is that text book knowledge supplements practical experiences rather than being the only source of information about the mechanics of modern technology.

The present study was not designed for inter-cultural comparisons, however, for illustrative purposes, a rough comparison of the mean scores of Class IV boys from the Pilot Study sample drawn from the Lagos urban area is made with those of Grade 11 (eleven) boys in American schools used for the norming of the DAT tests, on the Abstract Reasoning, Numerical Ability, and Mechanical Reasoning tests. It was observed that the Nigerian sample under reference had mean scores which are about the same as those of the American sample on the Abstract reasoning and Numerical Ability tests, but on the Mechanical Reasoning test the mean score of the two groups differ by more than 10 points in favor of the American sample. Another comparison shows that the mean score of Nigerian Class IV boys under reference is less than that of Grade 8 boys in the American schools used for the DAT norms by about two points. It is a fact that a lot of factors do not warrant such comparisons,

however, the point that is being made here is that informal interactions with technological objects is very essential for development of mechanical aptitude at the level at which it would be effective. Class IV is the last but one in the Nigerian present Secondary school systems, similarly, Grade 11 is last but one in the American High School system. Also the sample from Lagos urban area is used because Lagos, as the capital of Nigeria as well as the capital of the Lagos State, is the most developed city in Nigeria in terms of modern technological amenities and industries. A comparison of the mean scores of the Lagos sample used for the pilot study and those of the sample for the major study drawn from the other States of the Federation (Tables 2a vs. 3a & 3b), show that students in both the urban and rural located schools in Lagos State performed better on all the tests than their counterparts in the sample drawn from the other states in Nigeria. However, as has already been pointed out, the mean scores of boys and girls in schools located in Lagos urban area in the Mechanical Reasoning particularly, fall far below those of students in roughly comparable classes in the American schools used for the DAT norms.

Some might argue that the reason for such differences on the Mechanical Reasoning test as is pointed out above, is that the mechanical objects reflected in the test items

do not exist in Nigeria at the present time. However, a thorough look at the test items would not support such an argument. A possible explanation is that the Nigerian students are not having as much informal interactions with these objects as possible due to the reasons already discussed. And unless a deliberate effort is made to stimulate their interest and curiosity in these objects it might be difficult for Nigeria to produce the type of technicians she needs. The comments of Schwarz and Krug (1972) might be appropriate here, that is, "An individual who has not the background to answer questions about electricity (or gears or pulleys) when they appear on a test paper will have similar difficulties when he encounters them in a textbook or lecture" (p. 18). One might say that the ultimate effect of such poor backgrounds would be that the students might not gain enough insight into the workings of mechanical objects as to be able to deal with them effectively. However, the situation can be remedied by suitable educational policies.

One of such policies will be the introduction of massive aptitude testing programs in Nigeria in both upper primary and all secondary school levels. If the tests are administered every year and the students are made to understand that the records would be used in decision making for their academic and vocational future, they would make

special efforts to do well in these tests. This would lead to among other things, their informal interactions with the technological objects within their environments according to the stimulation of the items of these aptitude tests. By so doing, individual interests and abilities will begin to emerge.

It is therefore recommended that the aptitude tests be used initially for diagnostic and formative purposes. That is with the aim of stimulating the interests and curiosity of the students in exploring the modern technological objects around them. A profile record of each student's performance on the various types of the aptitude tests should be kept. In the upper secondary classes, or when each student must have taken the aptitude tests at least three times at the same period of different school years, performance on the various aptitude tests in conjunction with students' achievement tests scores and other relevant background information could be used to advise the students on their choices of vocations or areas of further studies.

It would also be in the best interest of the Nigerian government in its efforts to produce effective modern technologically oriented manpower, to provide relevant toys and other play facilities in the primary schools to supplement the teaching of science subjects

which should be pursued in earnest at this level of the country's educational system. In the secondary classes also, the curricular should be amended to provide for guided student tours of the major industries and other centers where the students would have opportunities to observe purposefully the technological objects at work. It implies that the government should provide the means of transportation and other facilities for the implementation of such programs.

## SUMMARY

Nigeria has embarked on transforming its traditional agrarian culture to that of technological industrialization. To accomplish this objective, she needs a technologically oriented manpower. It is argued that to get the right people for the right jobs, Nigeria needs to introduce an aptitude testing program in both upper primary grades and all the classes in secondary schools. These aptitude tests should be those found to be reliable and valid to predict abilities in a technological culture. It is felt that it would defeat the aim, if ability tests based on Nigerian traditional agrarian culture are developed to predict success in a technological culture, when the two cultures have not much in common.

It is realized, however, that Nigerian culture is in a transitional stage and that both the traditional and modern cultures influence the people's ways of life and thinking in varying degrees. It is expected that some of the local cultural and environmental factors existing in Nigeria as a result of this cultural

transition could affect the pattern of performance of the students on different types of aptitude tests developed in a technologically industrialized culture. In that case, the extent of the influence of these factors ought to be estimated and student scores on these tests interpreted accordingly.

The present study was designed to investigate the influence of specified cultural and environmental factors on Nigerian students performance on selected general and specific ability tests developed in advanced technological countries. The selected tests are five of the Differential Aptitude Tests (DAT) battery, namely, Verbal Reasoning, Numerical Ability, Abstract Reasoning, Mechanical Reasoning, and Space Relations. In addition to these tests, the Raven's Progressive Matrices was utilized. The effect on the aptitude tests performance of the following specified cultural and environmental factors: Sex-role, socio-economic status, general Western culture participation, urban-rural location of schools and residence, boarding versus non-boarding status, and number of school years, were examined.

The sample consisted of 1,230 Nigerian students in 21 secondary Grammar Schools, selected under stratified random sampling procedure. The specified cultural and

environmental factors, mentioned above, which were the independent factors under investigations, were the basis of stratification. The study was exploratory, and was meant to be hypotheses generating rather than hypotheses testing, in view of the fact that a very limited amount of scientific evidence has been collected, which are specifically related to the developing African nations to generate hypotheses based on specific situational variables operating in these nations.

The data were analyzed by the technique of Analysis of Covariance, (ANCOVA), with the specified factors listed above as the independent variables, and performance on the ability tests (test scores) as the dependent variables. Following the results of the ANCOVA details, a post-hoc analysis was made utilizing the techniques of multiple classification and matching.

The analyses and results of the data led to the following observations: (1) That the performance of Nigerian secondary school students on the Differential Aptitude Tests (DAT) battery as well as on the Raven's Progressive Matrices, depend, in general, on the individual level of Western culture participation.



(2) That performance on the Verbal, Numerical, and Abstract Reasoning tests as well as on the Raven's Progressive Matrices depend on both socio-economic status (SES) and Western culture participation (WCP), but more so on SES than on WCP. (3) That performance on the Mechanical Reasoning, and Space Relations Tests depend on WCP and not on SES. (4) That, in general, boys performed significantly better than girls in Numerical, Mechanical and Space Relations tests. (5) That in the urban located schools there was no significant difference in the performance of boys and girls on the Verbal and Abstract Reasoning tests as well as on the Raven's Progressive Matrices. (6) That in the rural located schools, boys performed significantly better than girls in all the tests, namely, the Verbal Reasoning, Numerical Ability, Abstract Reasoning, Mechanical Reasoning, and Space Relations tests, as well as the Raven's Progressive Matrices. (7) That both boys and girls in the urban located schools performed significantly better in all the ability tests than their counterparts in the rural located schools.

On the basis of the observations it was concluded that if the aptitude tests are used for selective purposes in Nigeria at the present, they will be biased against

students in the rural located schools. However, it is recommended that the tests could be used initially for diagnostic and formative purposes and to stimulate the interest and curiosity of students in technological objects around them. It is also suggested that in the higher secondary classes (IV & V) performance on the aptitude tests, along with other information could be used to advise students on choices of vocation or areas for further studies, provided that a student has taken the aptitude tests for at least three times during his secondary school career. Further research studies are also recommended to determine the predicting validity of the various ability tests for students from the various factorial groups discussed in the study for effective utilization of these tests for educational and vocational counselling.

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## APPENDIX A



*The regions of Nigeria*

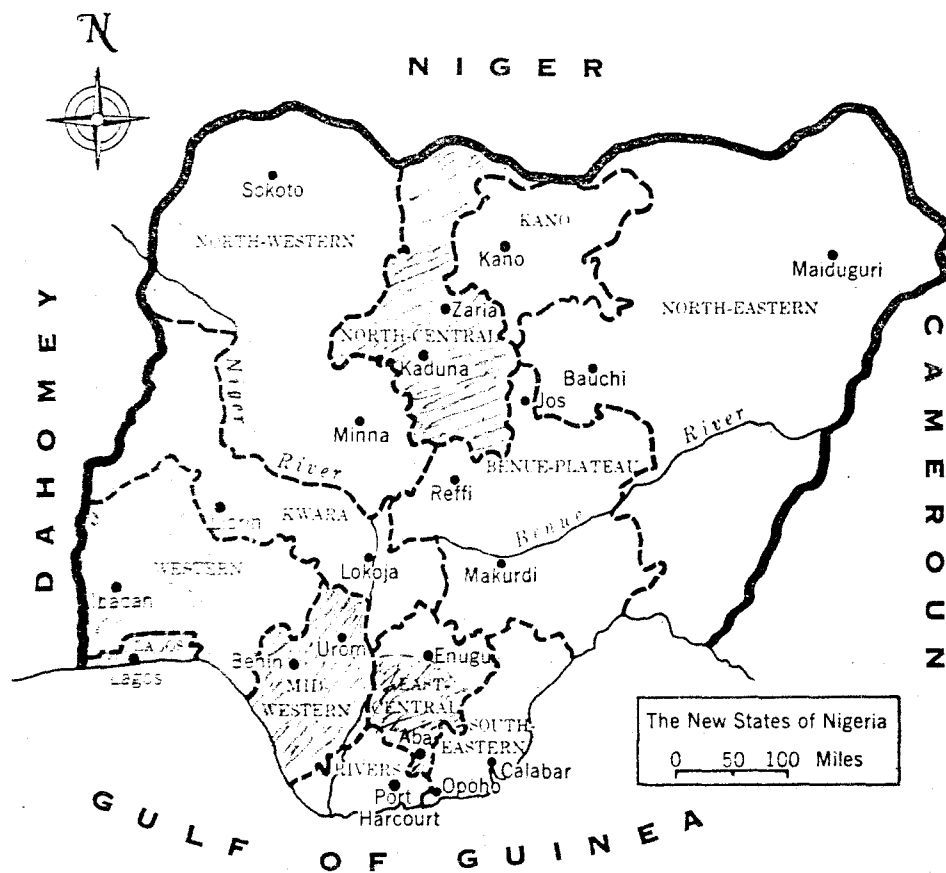
*Reprinted by permission from Foreign Affairs. Copyright 1972 by Council on Foreign Relations, Inc.*

The former political Regions in Nigeria which were later split first into 12 States, then into 19 States.

Taken from African Revolution by Alan Feinstein.

Quadrangle/ the New York Times Book Company, 1973

## APPENDIX B



Note: The shaded parts represent the areas covered in the sampling.

A map of Nigeria showing the 12 States

Taken from Nigeria: The Seeds of Disaster by John Hatch.

Henry Regenry Company, Chicago, 1970

## APPENDIX C



## List of Schools in the Sample

CATEGORY LABEL	CODE	ABSOLUTE FREQUENCY	RELATIVE FREQUENCY (PERCENT)
Loyola College Ibadan	1	60	4.9
Edo College Benin	2	60	4.9
Holy Ghost College Owerri	3	56	4.6
Government College Kaduna	4	59	4.8
Queens School Ibadan	5	59	4.8
Itohan Girls Grammar School Benin	6	59	4.8
Ovom Girls School Aba	7	60	4.9
Queen Amina College Kaduna	8	60	4.9
Ibeku High School Umuahia	9	61	5.0
African Church Gr. School Ibadan	10	62	5.0
Ologhoshere High School Benin	11	60	4.9
Government Sec. School Markarafi	12	59	4.8
Evboneka Gr. School Evboneka	13	59	4.8
Fatima College Ikire	14	60	4.9
Madona High School, Etiti	15	60	4.9
Eme-Ora Girls School Eme-Ora	16	60	4.9
Ezeoke Girls School, Ezeoke	17	36	2.9
Girls Sec. School Soba	18	60	4.9
Prospects High School, Abanla	19	60	4.9
Igbo-Elerin Gr. School, Abanla	20	60	4.9
Igieduma Gr. School, Igieduma	21	60	4.9

## APPENDIX D

D

TEST DEVELOPMENT AND RESEARCH OFFICE  
WEST AFRICAN EXAMINATIONS COUNCIL  
PRIVATE MAIL BAG 1076  
YABA - LAGOS.

193

Our Ref: RD.69

20th April, 1976.

The Permanent Secretary,  
Ministry of Education,  
Secondary School Section,

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Dear Sir,

Research Study

I am conducting a research study sponsored by the Ford Foundation under the auspices of the West African Examinations Council, aimed at adapting and developing some Aptitude Tests for Counselling purposes in Nigerian Secondary Schools. The purpose of the study is to investigate some of the probable effects of some Sub-Cultural factors such as sex, socio-economic status, residential and schooling environments (urban versus rural), would have on the performance of Nigerian students on the various sections of these test batteries. The batteries measure natural potentials in various fields of education as predictors of success in different occupational sectors. To ensure equal opportunity in students' choice of career, it is necessary to investigate if any of the above mentioned sub-cultural factors would constitute a handicap for the discovery of the natural ability of students within any of the composite groups, with the proposed tests.

The success of this study will depend on the cooperation I get from the various State Ministries of Education and the Secondary Schools that would constitute the sample for this study. Because of limited resources I cannot cover every State in the Federation, I have therefore randomly selected 6 States in which to conduct the research study and your State happens to be one of them. I plan to select 6 schools from each of the States on the following basis:

Urban Areas (Townships)

- 1 Boys School
- 1 Girls School
- 1 Mixed School

Rural Areas (Villages)

- 1 Boys School.
- 1 Girls School
- 1 Mixed School.

My target population in each school will compose of students in classes 4 and 5, and in each of those classes, 30 students will be randomly selected. That means I shall require 60 students from each participating school. Samples of the proposed tests and a questionnaire as well as a Vocational Interest Inventory will be administered to the selected students on agreed dates.

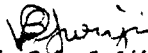
- 2 -

I have scheduled to start the testing on October 4, 1976. Before that date I plan to complete arrangements as to dates and time I shall be at each of the selected schools. I will come to your Ministry in latter part of May, 1976 to seek your help in selecting the Schools according to the stated criteria, as well as in contacting the Principals through your Ministry to fix the testing dates.

I expect sir, that you will please give me your maximum cooperation in order to make this study a success for the benefit of our future generation.

Thanking you in anticipation.

Yours truly,



Victoria B.C. Iwiji-Ijomah  
RESEARCH FELLOW

## APPENDIX E



*Mrs. Ijomah*  
*R.D., TEDRO*

MINISTRY OF EDUCATION  
INSPECTORATE DIVISION  
IBADAN · ~~WESTERN~~ STATE OF NIGERIA

Telephone: IBADAN 52340  
Telegram: ~~EDUCAT~~



Your Ref. No.....  
All communications to be addressed  
to the Permanent Secretary quoting  
Our Ref. No. INS. 2018/55.

Date 13<sup>th</sup> August 1976.

The Director,  
TEDRO,  
West African Examination Council,  
Yaba.

(For the personal attention of Miss V.B.C. Iwuji-Ijomah)

R e s e a r c h   S t u d y

Your letter No. RD.69 of the 20th April, 1976 refers  
please.

2. The principals have been contacted with regard to  
your letter and our subsequent discussion, and they have  
consented to the testing arrangements.
3. Enclosed please find the list of Schools and names  
of principals together with the testing dates.

*O.F. LEATUROTU*  
O.F. LEATUROTU (MRS),  
for Permanent Secretary,  
Ministry of Education.

## APPENDIX F

APPENDIX

F

Name of State O Y O

## URBAN AREA

	Name and Address of School	Name of Principal	Date of Testing
Boys' School	Loyola College, Ibadan.	Mr. G.B. Daramola (Acting).	14th September
Girls' School	Queen's School, Ibadan.	Mrs. C. O. Ogunbiyi	15th September
Mixed School	African Church Grammar School, Ibadan.	Mr. S. A. Dada	16th September

## RURAL AREA.

Boys' School	Fatima College, Ikire	Dr. J.C. Obemeata	17th September
Girls' School	Prospect High School Abanla via Ibadan (In lieu of girls)	Mr. O. Abodunrin	20th September
Mixed School	Igbo Elerin Grammar School, Bangbola, Ibadan East.	Mr. D.A. Oyewole	21st September



## APPENDIX G

Addressed to the Principals of the Secondary Schools listed below.

Research Study - MAEC

I am directed to inform you that your school has been chosen as one of the school in which some re-search will be conducted with the aim to develop some tests for Guidance purposes in Nigerian Secondary Schools. I am therefore to request you to give assistance and co-operation to this.

The researcher will be reporting to your school on the day shown on the table below. She will like to use about 30 Students each from Forms 4 and 5 for the study. However she will like to select the students by herself using a particular technique she is adopting for this research.

The following table shows dates on which we shall be in your school.

<u>SCHOOL</u>	<u>DATE OF TESTING</u>
Government College Kaduna	November 1st, 1976
Queen Amina College, Kaduna	November 2nd, 1976
Federal Government College, Kaduna	November 3rd, 1976
Government Secondary School, Makarfi	November 4th, 1976
Government Girls Secondary Sch., Soba.	November 5th, 1976
Government Commercial College, Maria.	November 6th, 1976

The testing will last about 4½ hours and will be split into 2 sessions as follows.

1st session 8.30 a.m. to 11.15 a.m. - Break 30 Minutes - 2nd session 11.45 a.m. - 1.30 p.m. We hope you will give your maximum cooperation to this study.

(D. H. Ewe)  
for Permanent Secretary

...../2

## APPENDIX H

APPENDIX H

- 2 -

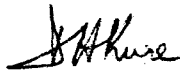
NCE/CIE/22A/Vol.1/246AMinistry of Education,  
Kaduna.

16th June, 1976.

Copy to:

Miss Victoria B.C. Iwuji-Ijomah,  
Research Department,  
TEDRO/NAEC,  
PMB. 1076,  
Yaba-Lagos.

Above for your information and necessary action refer~~and~~  
your letter Ref: RD.69 of 20<sup>th</sup> April, 1976. The completed form is  
herein enclosed for your use.



(D. H. KURE)  
for: Permanent Secretary,  
Ministry of Education,  
Kaduna.

## APPENDIX J

WESTERN CULTURE PARTICIPATION INVENTORY

This Inventory is a means of determining how far the cultural objects and activities of the Western countries have become part of our life in Nigeria. It will also help us to determine to what extent Nigerian Students from various parts of the country are exposed to these objects and activities. Your name is required only for identification of your work. The information you give will be used for research purposes only, not for personal assessment of wealth or position of your parents. Please give as much correct information as possible.

The examiner will explain the items, and you will please make your response as he/she goes on.

Your Name \_\_\_\_\_

Your Number \_\_\_\_\_

FOR OFFICIAL USE ONLY

SES \_\_\_\_\_

WCP \_\_\_\_\_

P A R T 1

Name of your school: \_\_\_\_\_

Address: \_\_\_\_\_

Instruction:

Put an X in the appropriate box beside the item that is applicable to you. Check only one item within each number unless where instructed to do otherwise. If you want to change your response, erase completely your former X and mark the correct box.

1. Your class: Form three ☐ Form four ☐ Form five ☐
2. Your number:  (write your number in the box)
3. Sex: Male ☐ Female ☐
4. Location of your school: Village ☐ City ☐
5. I am a Day Student ☐ a boarder ☐
6. We live in a village ☐ a city ☐
7. My father's level of education falls within the following class:  
(Please mark only one)

- (i) No schooling at all ☐
- (ii) Between primary 1 and 6 inclusive ☐
- (iii) Between secondary class 1 and 4 inclusive ☐
- (iv) Holder of School Certificate or G.C.E. (OL) or Higher Elementary ☐
- (v) Holder of H.S.C. or G.C.E. (AL) ☐
- (vi) Holder of one of these professional or academic certificate/degree: B.A.; B.Sc.; L.L.B.; ACCA; N.C.E.; or equivalent ☐
- (vii) Holder of a post-graduate degree: M.A.; M.Sc.; A.L.A.; Ph.D.; Ed.D.; M.B.A.; M.D.; D.S.; or equivalent ☐

(continued)

(PART 1, continued)

8. My mother's level of education falls within the following class:  
(Please mark only one)

- (i) No schooling at all ☐
- (ii) Between primary 1 and 6 inclusive ☐
- (iii) Between secondary class 1 and 4 inclusive ☐
- (iv) Holder of School Certificate or G.C.E. (OL) or  
Higher Elementary ☐
- (v) Holder of H.S.C. or G.C.E. (AL) ☐
- (vi) Holder of one of these professional or academic  
certificate/degree: B.A.; B.Sc.; L.L.B.; ACCA;  
N.C.E.; or equivalent ☐
- (vii) Holder of a post-graduate degree: M.A.; M.Sc.; A.L.A.;  
Ph.D.; Ed.D.; M.B.A.; M.D.; D.S.; or equivalent ☐



P A R T II

Instructions: Answer Both Sections A & B

Go through the list carefully; at the end of each number, three spaces are provided:

Put "X" in the 1st space if you have the object in your house OR "X" in the second space if you do not have the object but know what it is and what it is used for OR "X" in the 3rd space if you do not know what the object is. Please do not mark more than one space for the item.

SECTION A

	(1) have it	(2) Don't have it but know what it is	(3) Don't know it
1. a bicycle . . . . .	( )	( )	( )
2. a television . . . . .	( )	( )	( )
3. a radio . . . . .	( )	( )	( )
4. a sewing machine . . . . .	( )	( )	( )
5. an electric fan (ceiling or table fan) . . . . .	( )	( )	( )
6. an air conditioner . . . . .	( )	( )	( )
7. a telephone . . . . .	( )	( )	( )
8. an electric iron . . . . .	( )	( )	( )
9. an electric cooker . . . . .	( )	( )	( )
10. a gas cooker . . . . .	( )	( )	( )
11. electric kettle . . . . .	( )	( )	( )
12. a kerosene cooker . . . . .	( )	( )	( )
13. an electric food mixer or blender . . . . .	( )	( )	( )
14. a kitchen sink . . . . .	( )	( )	( )

SECTION A  
(continued)

	(1)	(2)	(3)
	Have it	Don't have it but know what it is	Don't know it
15. a flush toilet . . . . .	( )	( )	( )
16. a shower . . . . .	( )	( )	( )
17. a bath tub . . . . .	( )	( )	( )
18. a freezer (not as a part of a refrigerator) . . . . .	( )	( )	( )
19. a washing machine/dryer . . . . .	( )	( )	( )
20. a motorcycle/Honda . . . . .	( )	( )	( )
21. a car . . . . .	( )	( )	( )
22. a refrigerator . . . . .	( )	( )	( )
23. an electric shaver . . . . .	( )	( )	( )
24. an electric water heater (not kettle) . . . . .	( )	( )	( )
25. a swimming pool . . . . .	( )	( )	( )
26. a vacuum cleaner . . . . .	( )	( )	( )
27. a book case . . . . .	( )	( )	( )
28. a chest of drawers . . . . .	( )	( )	( )
29. trunk box(es) . . . . .	( )	( )	( )
30. a tape recorder . . . . .	( )	( )	( )
31. a record player/radiogram . . . . .	( )	( )	( )

SECTION B

I have seen the following objects and can describe them:

	<u>Yes</u>	<u>No</u>
1. a sliding door . . . . .	( )	( )
2. a revolving door . . . . .	( )	( )
3. louver window . . . . .	( )	( )
4. an escalator or moving stairs . . .	( )	( )
5. an elevator or lift . . . . .	( )	( )
6. a weighing balance . . . . .	( )	( )
7. a swinging board . . . . .	( )	( )
8. a water tank . . . . .	( )	( )
9. a wheel chair . . . . .	( )	( )
10. a file cabinet . . . . .	( )	( )
11. a cash register . . . . .	( )	( )
12. an overhead bridge . . . . .	( )	( )
13. a fly-over bridge . . . . .	( )	( )

I have visited the following places and I can describe the activities that go on there:

	<u>Yes</u>	<u>No</u>
14. a train (railway station) . . . . .	( )	( )
15. an aerodrome (airport) . . . . .	( )	( )
16. a wharf (seaport) . . . . .	( )	( )
17. a mine (coal, iron, oil, zinc, etc.)	( )	( )
18. a manufacturing industry (soap, plastic, shoes) etc. . . . .	( )	( )
19. an electric powerhouse . . . . .	( )	( )

SECTION B  
(continued)

	<u>Yes</u>	<u>No</u>
20. an aquarium . . . . .	( )	( )
21. a museum . . . . .	( )	( )
22. a zoo . . . . .	( )	( )
23. a dam . . . . .	( )	( )
24. a theatre . . . . .	( )	( )
25. a football stadium . . . . .	( )	( )
26. an art gallery . . . . .	( )	( )
27. I attended a Private Nursery School (write the name).....	( )	( )
28. I take private piano lessons outside school hours . . . . .	( )	( )
29. I know how to drive a car . . . . .	( )	( )
30. My parents buy and read newspapers daily . . . . .	( )	( )
31. I own a bicycle . . . . .	( )	( )

Mention 5 toys which you played with when you were a child:

32. ....
33. ....
34. ....
35. ....
36. ....

## APPROVAL SHEET

The dissertation submitted by Victoria Belle Chigoziri Iwuji has been read and approved by the following Committee:

Dr. Samuel T. Mayo, Director  
Professor, Foundations of Education,  
Loyola University of Chicago

Dr. Jack Kavanagh  
Assistant Professor and Chairman  
Foundations of Education, Loyola University  
of Chicago

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The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

11/29/77  
Date

Samuel T. Mayo  
Director's Signature